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NATIONAL DAM SAFETY PROGRAM. HILLTOP FISHING LAKE DAM (MO 40064--ETC(U)
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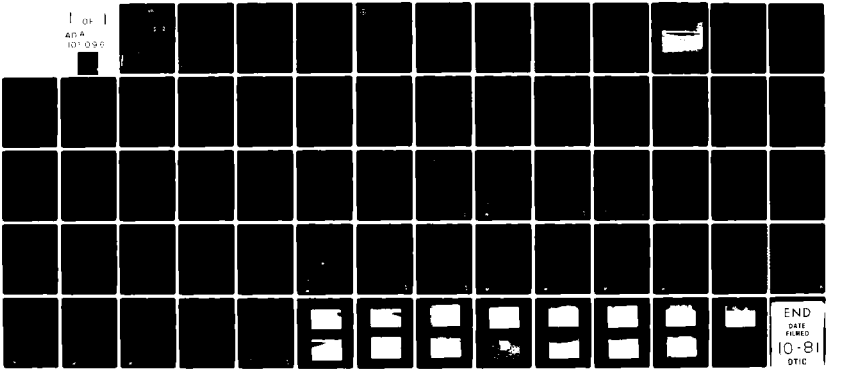

MISSISSIPPI-ST. FRANCIS RIVER BASIN

HILLTOP FISHING LAKE DAM
DUNKLIN COUNTY, MISSOURI
MO 40064

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH 1981

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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Hilltop Fishing Lake Dam
Dunklin County, Missouri
Missouri Inventory No. 40064

This report presents the results of field inspection and evaluation of the Hilltop Fishing Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

4 JUN 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

5 JUN 1981
Date

MISSISSIPPI-ST. FRANCIS RIVER BASIN

HILLTOP FISHING LAKE DAM
DUNKLIN COUNTY, MISSOURI
MISSOURI INVENTORY NO. 40064

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Crawford, Murphy & Tilly, Inc., Springfield, Illinois
A & H Engineering Corporation, Carbondale, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

MARCH, 1981

PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I investigation. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigation, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. Additional data or data furnished containing incorrect information could alter the findings of this report.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

PHASE I INSPECTION REPORT
NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS

Name of Dam:	Hilltop Fishing Lake Dam
State Located:	Missouri
Inventory Number:	MO 40064
County Located:	Dunklin
Stream:	Unnamed Tributary to Ditch No. 1 of District 17
Date of Inspection	4 December 1980

BRIEF ASSESSMENT:

Hilltop Fishing Lake Dam was inspected by a team of engineers from Crawford, Murphy & Tilly, Inc., of Springfield, Illinois and A & H Engineering Corporation of Carbondale, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Hilltop Fishing Lake Dam is an earthfill embankment constructed in 1976 or 1977 across an unnamed tributary to Drainage Ditch No. 1 of District 17. The dam is owned by Tom and Robert Powers, both of Campbell, Missouri. The lake is used for fishing. Fishermen pay a fee to fish in the lake.

Based on the guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately two miles downstream of the dam. Located within this zone are more than twenty dwellings and a primary and a secondary highway. This dam is in the small size classification due to its height of 24.9 feet and its maximum storage capacity of 127 acre-feet. A small size dam has a height greater than 25 feet but less than 40 feet and/or a maximum storage capacity greater than 50 acre-feet but less than 1,000 acre-feet.

Our inspection and hydrologic and hydraulic analyses indicate that the capacity of the dam meets the criteria set forth in the guidelines for a dam having the above size and hazard potential. The dam will hold and pass approximately 65 percent of the Probable Maximum Flood (PMF) without overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam

of small size with a high downstream hazard potential pass 50 percent to 100 percent of the PMF. The dam has a relatively small storage capacity of 127 acre-feet and a small height of 24.9 feet. The dam also has a very small drainage area of 15 acres and there is a broad flood plain downstream from the dam. Considering these facts, 50 percent of the PMF has been determined to be the appropriate design storm. The 1 percent probability flood (100-year flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being equalled or exceeded in any given year.

The dam appeared to be in poor condition. Several deficiencies were noted during the inspection. The face of the embankment had varying slopes with some of them being rather steep. There are serious erosion problems on most of the dam, including shoreline erosion due to wave action. There are also numerous animal holes in the embankment. There is a poor vegetal cover on most of the dam. Another deficiency is the lack of seepage and stability analyses records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Nathan Wilcoxon

Nathan Wilcoxon, P.E.
Crawford, Murphy & Tilly, Inc.

Guy Freese, P.E.
A & H Engineering Corporation

Timothy P. Tappendorf

Timothy P. Tappendorf, E.I.T.
Crawford, Murphy & Tilly, Inc.

PHOTOGRAPH 1. OVERVIEW OF HILLTOP FISHING LAKE DAM.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HILLTOP FISHING LAKE DAM
MISSOURI INVENTORY NO. 40064

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Hilltop Fishing Lake Dam located near Campbell, Missouri in Dunklin County.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams. These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Hilltop Fishing Lake is an earthfill structure approximately 24.9 feet high and 1,500 feet long at the crest. The embankment has a horseshoe shape and forms three sides of the lake. The dam has no spillway or drawdown facility.

B. Location:

The dam is located about 1 mile northwest of Campbell, Missouri. The dam is located across a tributary to a drainage ditch known as Ditch No. 1 of District 17. The longitude of the dam is 90° 5.4' west and the latitude is 36° 30.7' north. The dam and watershed are located within Section 33 of Township 22 North, Range 9 East of the 5th Principal Meridian. The dam and watershed are within the Valley Ridge, Missouri 15 minute quadrangle map. Included in Appendix A are a location map for the dam on Plate 1 and a vicinity map on Plate 2.

C. Size Classification:

Hilltop Fishing Lake Dam has an embankment height of approximately 24.9 feet and a maximum storage capacity of approximately 127 acre-feet. Therefore, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a potential high hazard dam. The estimated damage zone extends approximately 2 miles downstream of the dam. Located within this zone are more than twenty dwellings and a primary highway, U.S. Route 62, and a secondary highway, Missouri State Route 53. The affected items in the damage zone were verified by the inspection team.

E. Ownership:

The dam is owned by Tom Powers, Route 2, Campbell, Missouri 63933, telephone 314-246-2973 and by Robert Powers, Route 2, Campbell, Missouri 63933, telephone 314-246-2979.

F. Purpose of Dam:

The dam and lake were built for recreational and commercial purposes. Fishermen are allowed to fish in the lake for a fee.

G. Design and Construction History:

According to Mr. Tom Powers, one of the owners, the dam was constructed in 1976 or 1977. The dam was designed by Mr. Powers with advice from personnel from the Dunklin County Soil Conservation Service. No detailed design was done and no design computations were recorded or design drawings made. According to Mr. Charlie Champ of the Dunklin County Soil Conservation Service, the embankment slopes were discussed and the width of the base of the embankment necessary to obtain those slopes was computed. Mr. Champ indicated that no design surveys or official technical assistance was performed.

Mr. Powers said that the upstream side of the embankment was designed to have a 3 horizontal to 1 vertical slope and the downstream side of the embankment was designed to have a 2 horizontal to 1 vertical slope. He said he remembered that the embankment was to have a height of 36 feet with a bottom width of 202 feet at the point of maximum fill height. He said that he allowed for 5% settlement when building the dam. Mr. Powers said that the SCS was doing a soil survey of Dunklin County prior to construction of the lake and took soil samples at the damsite. He said they informed him that the lake should hold water. Mr. Champ said that to his knowledge the only record of the soil samples is the surface soil classification mapping in the "Soil Survey of Dunklin County, Missouri" which was issued in March, 1979.

Mr. Powers indicated that he constructed the dam using earth movers pulled behind farm tractors and a bulldozer for shaping. He said that about 18 inches of soil was removed where the embankment was to be located to have undisturbed earth as the base of the dam. He said the borrow area for the fill material for the embankment was the present lake area. The fill material was placed several inches at a time and compaction was obtained from the equipment placing the fill and from the bulldozer.

Mr. Powers said that there is a spillway channel located on the north side of the dam near the left abutment. In this report right and left orientation are based on looking in the downstream direction. He said the spillway crest was to be 2 feet lower than the crest of the dam. Our surveys indicate that the elevation of the crest of the intended spillway channel is 1.0 foot higher than the low point of the dam crest.

No failures or modifications of the dam are known to have occurred since its construction.

H. Normal Operating Procedures:

There is no operating equipment at the dam. There are three ponds located upstream from the lake. There is an 8 inch diameter well with a pump driven by an electric motor which discharges into the pond farthest upstream. The outflow from the upstream pond enters the second pond, the outflow from the second pond enters the third pond, and the outflow from the third pond enters the lake. Due to the small size of the drainage area compared to the lake area, water from the well must be pumped to maintain the water level in the lake. The level of the lake has been controlled by rainfall, runoff, pumping from the well, evaporation, and seepage of lake water into the ground. According to Mr. Powers, there has never been outflow from the lake.

Mr. Powers said that he has no schedule of operation of the pump but operates it whenever he feels like it.

1.3 PERTINENT DATA:

A. Drainage Area (Acres):	15
B. Discharge at Damsite (CFS):	
Maximum known flood at damsite	Unknown (there has been no overflow)
Drawdown facility capacity at maximum pool	None
Spillway capacity at maximum pool	None
C. Elevation (Ft. above MSL):	
Top of dam	404.9
Streambed at downstream toe of dam	380.0
Normal pool	None

Spillway crest		None
Pool elevation during inspection 4 Dec. 1980		394.4
Apparent high water mark		400.0
Maximum tailwater		Unknown

D. Reservoir Lengths (Feet):

At top of dam		900
At spillway crest		Not applicable

E. Storage Capacities (Acre-Feet):

At top of dam		127
At spillway crest		Not applicable
At pool level during inspection 4 Dec. 1980		34
At elevation of apparent high water mark		79

F. Reservoir Surface Areas (Acres):

At top of dam		10.4
At spillway crest		Not applicable
At pool level during inspection 4 Dec. 1980		7.2
At elevation of apparent high water mark		8.8

G. Dam:

Type		Earthfill embankment
Length of crest (feet)		1,500
Height (feet)		24.9
Top width (feet)		12
Side slopes (Horiz.:Vert.)	Upstream:	Variable slopes. See cross sections on Plates 5 and 6 of Appendix A.
	Downstream:	
Zoning		None
Impervious core		None

Cutoff	None
Grout curtain	None
H. Diversion and Regulating Tunnel:	None
I. Spillway:	None
J. Regulating Outlets:	None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

Mr. Tom Powers, one of the owners of Hilltop Fishing Lake Dam, said that he designed the dam with help from Dunklin County Soil Conservation Service personnel and that the design was approved by the SCS. Mr. Charlie Champ of the Dunklin County SCS said that no official technical assistance was given to Mr. Powers in the design of the dam but that he did discuss the design of the dam with Mr. Powers. No design computations were recorded and no design drawings were made.

A. Surveys:

Mr. Powers indicated that he could not remember if any surveys were done at the damsite before or during construction.

B. Foundation and Embankment Design:

Mr. Powers indicated that the upstream slope of the embankment was designed to have a 3:1 slope and the downstream slope was designed to have a 2:1 slope. He said that he allowed for 5 percent settlement of the embankment.

Soil sampling was done at the lake site prior to construction of the dam by SCS personnel as part of a soil survey mapping for Dunklin County, Missouri. Mr. Powers said that the SCS personnel told him that the lake should hold water. Mr. Charlie Champ indicated that he had no records of the soil sampling in that area other than the surface soil classification mapping found in "Soil Survey of Dunklin County, Missouri," because the sampling was done by State soil scientists and not county personnel.

C. Hydrology and Hydraulics:

No hydrologic or hydraulic design computations were performed for the dam and watershed. Mr. Powers said that a spillway channel was built and that its crest was to be 2 feet below the low point of the dam, but the field survey indicated that the low point of the dam was 1.0 below the high point of the intended spillway channel.

2.2 CONSTRUCTION:

According to Mr. Powers, he constructed the dam in 1976 or 1977 using earth movers pulled behind farm tractors and a bulldozer for shaping. About 18 inches of soil was stripped under the dam so that it would rest on undisturbed earth. The fill material was obtained from the present lake area and was placed by the earth movers in layers several inches thick. Compaction of the fill was obtained from the equipment placing the fill and from the bulldozers.

2.3 OPERATION:

There is no operating equipment at the dam. There are three ponds upstream from the lake. There is an 8 inch diameter water supply well with a pump driven by an electric motor which discharges through a 4 inch diameter pipe into one of the ponds. The outflow from that pond flows into the other two ponds and finally into the lake. The only operating equipment affecting the level of the lake is the well. The level of the lake has been controlled by the rainfall, runoff, pumping from the well, evaporation, and movement of lake water into the groundwater table.

Mr. Powers said that he operates the pump whenever he feels like it and that he likes to keep the lake level near the apparent high water mark at elevation 400.0. He tries to limit his pumping because of the high cost of operating the pump. The lake level was low during the inspection because of an extended dry period.

2.4 EVALUATION:

A. Availability:

The dam was designed and constructed by Mr. Tom Powers and information concerning the design and construction was obtained from him. No design computations were recorded, no design drawings were made and no construction records were kept and the information obtained was related by Mr. Powers from what he could remember.

B. Adequacy:

Due to the fact that no engineering data records were available, a detailed assessment of the design and construction of this structure could not be made. The information related by Mr. Powers in combination with the field survey and visual inspection, is considered adequate to support the conclusions in this report. However, the fact that no seepage and stability analyses comparable to the requirements of the Recommended Guidelines for Safety Inspection of Dams were available is a deficiency which should be rectified. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

The limited information related by Mr. Powers seemed to be valid. However, this information is insufficient to evaluate the adequacy of the design.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 4 December 1980. The inspection team consisted of personnel from Crawford, Murphy & Tilly, Inc. of Springfield, Illinois and from A & H Engineering Corporation of Carbondale, Illinois. The members were:

Nathan Wilcoxon, P.E. - Crawford, Murphy & Tilly, Inc.
Guy Freese, P.E. - A & H Engineering Corporation
Timothy Tappendorf, E.I.T. - Crawford, Murphy & Tilly, Inc.

The field inspection included the determination of dimensions and elevations of the dam and appurtenances necessary to show as a minimum a plan view, a dam crest profile, a spillway profile and section, and pertinent cross sections of the dam. For this report all elevations were obtained using the centerline of Missouri State Route 53 at its intersection with County Route H as elevation 320.0 above Mean Sea Level. This elevation was obtained from information on the Valley Ridge, Missouri 15 minute quadrangle map. A visual inspection of the dam, drainage area, and downstream channel was performed and photographs were taken of each of them. The owners were unavailable at the time of the inspection, but were interviewed by telephone after the inspection. Mr. Charlie Champ of the Dunklin County SCS was also interviewed by telephone following the inspection.

Maps and general drawings of the dam and appurtenances are presented on Plates 1 through 6 in Appendix A and a hydrologic and hydraulic analysis is presented in Appendix B. Photographs of the dam and appurtenances are presented in Appendix C.

B. Regional and Project Geology:

The general southeastern Missouri area is underlain wholly or partially by Coastal Plain sediments. The Ozark Escarpment, which is the northwestern boundary, divides the lowland area from the Ozark Province. This is an irregular boundary which trends northeast by southwest from the southern sections of Cape Girardeau County through Bollinger County, Wayne County, Butler County and into Arkansas. All of Scott County, Stoddard County, Dunklin County, New Madrid County, Mississippi County and Pemiscot County (of the Mississippi embayment) are underlain by sediments of the Ozark Escarpment.

The Mississippi embayment is a broad arm of the Gulf Coastal Plain which extends up the Mississippi River Valley from the Gulf of Mexico. The outer rim of this embayment is outlined by outcrops of consolidated Paleozoic sediments. The embayment is structurally a downwarped, spoon-shaped trough developed on the Paleozoic rocks. Unconsolidated to poorly consolidated sediments of Mesozoic and Cenozoic ages have been deposited in this trough (whose axis trends N30°E and is roughly marked by the course of the Mississippi River).

One of the most prominent topographic features of the embayment is Crowley's Ridge of central Stoddard County and northern Dunklin County. The dam site lies at the extreme southwestern edge of Crowley's Ridge

The subsurface geology of Dunklin County of the Mississippi embayment is comprised of Quaternary alluvium overlying the Wilcox, Lafayette and Midway groups of the Tertiary System. These formations overlie Cretaceous bedrock which extends up to the northern base of the Crowley's Ridge regions. The Crowley's Ridge axis is generally parallel with a probable fault zone which extends northeast through Stoddard and Scott Counties.

A layer of light brown clayey silt loess covers the dam site area and is exposed upstream and downstream of the dam. The loess soil may range in thickness of up to 50 feet. Although not observed in the project area, Tertiary deposits belonging to the Lafayette, Wilcox and Midway groups underlie the surface material.

The Lafayette formations consist of gravel and interbedded sand and clay and is approximately 150 feet thick. The Wilcox group consists of the Ackerman and Holly Springs formations, which is approximately 250 feet thick. The Ackerman and Holly Springs formations consist of sand with several well developed clay zones. A thick basal sand exists in the lower sections. The Midway group consists of the Clayton and Porters Creek formation. The Clayton formation in southeast Missouri consists of glauconitic limestone and calcareous clay. The Porters Creek formation consists of blue-gray clay with siderite and silt in the upper sections and glauconitic calcareous clay in the lower sections. The approximate thickness of this group is 500 feet.

The dam site is located in Seismic Zone 3 as shown on the Seismic Zone Map on Plate 3 of Appendix A. The site is located west of the New Madrid area which is seismically active at the present time.

C. Dam:

Hilltop Fishing Lake Dam is an earthfill dam with a height of approximately 24.9 feet and a length at the crest of approximately 1,500 feet. There is no spillway and no drawdown facility at the dam.

The horizontal alignment of the crest has a horseshoe shape and the dam forms three sides of the lake. The approximate horizontal alignment of the crest can be seen on the Plan View given on Plate 4 of Appendix A. The Plan View includes station numbers from 0+00 to 15+00 as a reference of location on the dam. There is a ramp cut in the earth at the right abutment. The ramp is 10 feet wide at the bottom and has approximately 3:1 side slopes. It is apparently used as a boat access to the lake. An overview of the dam is given on Photograph 1 at the front of the report. A view from the left abutment is shown on Photograph 2 and a view from the right abutment is shown on Photograph 3 in Appendix C.

The embankment appears to be in poor condition. The vertical alignment of the crest is not uniform and the crest elevation varies from 404.9 to 410.7. There is no apparent reason for this variation in elevation other than the fact that it was constructed that way. A profile of the crest can be seen on Exhibit 3 of Appendix B.

The upstream and downstream slopes of the dam are not uniform. The slopes vary from 1.7:1 to 8:1 at different locations on the dam. A portion of the upstream slope near the left abutment which has a flat slope can be seen in Photograph 4. The upstream slope also has a slight drop and a change in slope just below the high water mark due to shoreline erosion from wave action. This shoreline erosion can be seen in Photograph 5 of Appendix C. Cross sections at Station 5+60 and Station 11+00 are shown on Plates 5 and 6 respectively.

The maximum height of the fill as surveyed in the field was 27.9 feet at Station 5+60. The height of the dam for the determination of size classification is 24.9 feet which was measured from the natural bed of the stream at the downstream toe to the maximum water storage elevation. This height is less than the embankment height at Station 5+60 because the crest elevation at Station 5+60 is greater than the maximum water storage elevation of 404.9.

All of the embankment had a thin grass cover and no trees were growing on the embankment. It appeared that cattle had recently been grazing on the dam and they had apparently caused deterioration of the grass cover. Also vehicles had been driven on the crest of the dam and had caused deterioration of the grass cover. Serious erosion has occurred on much of the upstream and downstream faces of the dam. An erosion gully more than a foot deep and several feet wide was located on the upstream face at Station 1+30 and is shown on Photograph 6. A view of erosion occurring on the downstream edge of the crest and on the downstream face is shown on Photograph 7. A view of the downstream face of the dam near the center of the dam is shown on Photograph 8. There were several holes on the crest of the dam from Station 7+00 to Station 11+00 which apparently had been caused by burrowing animals and had been enlarged by erosion. A view of one of these holes is given on Photograph 9.

No surface cracks or unusual movement or cracking at or beyond the toe of the dam was noted. No evidence of seepage was noted and no foundation drains were observed.

A shallow soil sample was obtained from the embankment near the center of the crest. The sample was classified as a light brown to reddish-brown clayey silt (ML). The potential for erosion is high for this soil type.

D. Appurtenant Structures:

There is no spillway or drawdown facility.

E. Reservoir and Watershed:

The watershed for Hilltop Fishing Lake contains approximately 15 acres. At the water level elevation of 394.4 on the day of the inspection the lake area was about 48% of the watershed area and at the top of dam elevation of 494.9 the lake area would be about 70% of the watershed area. A view of the lake and the watershed from the dam is shown on Photograph 10.

The remainder of the watershed consists of three small ponds and a sparsely wooded area. A view of the wooded area is given on the right side of Photograph 11. There is an 8 inch diameter well with a pump driven by an electric motor which discharges through a 4 inch diameter pipe into the pond farthest upstream. The discharge pipe from the well can be seen in Photograph 12. The flow then passes from the upstream pond through the other two ponds before entering the lake. A view of the two ponds farthest upstream is given on Photograph 13.

About 50% of the wooded area has soil belonging to the Memphis Series which is in hydrologic Group B and the other 50% of the wooded area has soil belonging to the Loring Series which is in hydrologic Group C. Sedimentation of the lake has occurred due to the erosion of the upstream face of the dam. There has also been severe erosion from the slope on the upstream edge of the lake which was formed when the borrow material for the dam was cut from the lake area. A view of this severe erosion is shown on Photograph 14. Sedimentation from the wooded area of the watershed has been minimal. Although there has been sedimentation due to the erosion on the slopes surrounding the lake, its effect on the storage capacity of the lake is minimal because the lake is such a large percentage of the watershed.

F. Downstream Channel:

Since there is no spillway at Hilltop Fishing Lake, there is no discharge channel from the lake. There is a draw just downstream of Station 5+60 and this joins the downstream channel about 125 feet from the dam. The draw is covered with brush and it can be seen in Photograph 15. The downstream channel extends approximately 0.6 miles before crossing under Missouri Route 53 and then extends another 0.4 miles before entering Campbell, Missouri. Several dwellings located adjacent to the downstream channel about 0.3 miles downstream of the dam can be seen on Photograph 16. The channel can be seen at the right edge of the photograph.

3.2 EVALUATION:

Several deficiencies exist which need to be corrected. The lack of a seepage analysis and a stability analysis, including seismic loading, is a deficiency which should be corrected.

There are erosion problems due to surface runoff on most of the dam surface with severe erosion at several locations. Adding to the erosion problems are animal holes which increase the deterioration of the dam. There is also severe erosion on the slope formed by the removal of the borrow material for the dam on the west edge of the lake. There is also severe shoreline erosion of the dam due to wave action. The erosion problems have been accelerated because of the poor vegetal cover on the dam. The grazing of cattle on the dam and the driving of vehicles on the dam have added to the deterioration of the vegetal cover.

All erosion gullies and the shoreline erosion should be repaired and reseeded and a better grass cover promoted to help control future erosion problems. Any burrowing animals should be removed or destroyed and their burrows filled. Cattle should not be allowed to destroy the grass cover on the dam. If these erosion problems are not corrected the dam will continue to deteriorate and the structural stability of the dam may be threatened.

The dam was apparently constructed with the variable slopes that were observed during the inspection and some of these slopes are rather steep. The extent of the damage to the embankment by the burrowing animals could not completely be assessed by the visual inspection. These factors should also be taken into account when considering the structural stability of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There is no operating equipment at Hilltop Fishing Lake Dam. There is, however, an 8 inch diameter well with a pump driven by an electric motor which discharges into one of three ponds located upstream of the lake. The discharge flows through these three ponds and into the lake. There is no spillway at the lake and the lake level has been controlled by rainfall, runoff, water pumped from the well, evaporation, and seepage of the lake water into the ground. There has never been any outflow from the lake. Mr. Tom Powers, one of the owners of the lake, said that the pump is not operated on a regular schedule but he runs it when he feels like it. He indicated that normally he likes to keep the level of the lake near elevation 400.0. He limits his pumping because of the high cost of the electricity to run the pump. There had been an extended dry period before the inspection which had caused the lake level to be low.

4.2 MAINTENANCE OF DAM:

Maintenance of the dam has been minimal. There is no schedule of regular maintenance. No maintenance had been performed recently on the erosion gullies or to the surface cover of the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Maintenance is provided for the pump at the well located upstream of the dam as needed. There are no operating facilities at the dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

No warning system is known to exist.

4.5 EVALUATION:

Maintenance of the dam should be improved. Erosion gullies on the dam and the shoreline erosion should be repaired. A better vegetal cover on the dam should be promoted. All burrowing animals should be removed or destroyed and their burrows filled. Maintenance should be performed regularly and records kept of the maintenance performed. The operation of the pump at the well should be based on the lake level as discussed in Section 5.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

No hydrologic or hydraulic design computations for Hilltop Fishing Lake Dam and its watershed were done.

The significant dimensions of the dam and reservoir were measured or surveyed on the date of inspection or estimated from available topographic mapping. The map used in the analysis is the 15 minute U.S. Geological Survey quadrangle sheet for Valley Ridge, Missouri, dated 1956. Surface soil information was available from mapping obtained from the Dunklin County Soil Conservation Service.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for the lake and watershed. Information received from Mr. Tom Powers indicated that there has never been any outflow from the lake.

C. Visual Observations:

A description of the watershed and reservoir is given in Paragraph 3.1 E. There is no spillway at the dam. The lake level has apparently been controlled in the past by rainfall, runoff, pumping from the well upstream from the lake, evaporation, and movement of the lake water into the groundwater table. An apparent high water mark was observed and found to be 4.9 feet below the low point of the dam. No evidence that the dam had been overtopped was noted during the inspection.

A description of the downstream channel is given in Paragraph 3.1 F. The downstream hazard zone extends approximately 2 miles downstream and includes more than twenty dwellings. Also included in the hazard zone are Missouri State Route 53 and U.S. Route 62.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix B, the dam has the capacity to store and pass approximately 65 (to the nearest 5 percent) percent of the Probable Maximum Flood (PMF) without being overtopped based upon the lake not being filled above an elevation of 400. Since the dam has no spillway, all of this capacity is storage capacity.

The Probable Maximum Flood is defined as the flood that may be expected from the most severe combinations of critical meteorologic and hydrologic conditions that are reasonably possible in a region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this dam which is in the small size category with a high downstream hazard potential classification store or pass 50 percent to 100 percent of the PMF without overtopping. The dam has a relatively small storage

capacity of 127 acre-feet and a small height of 24.9 feet. The dam also has a very small drainage area and there is a broad flood plain downstream from the dam. Considering these facts, 50 percent of the PMF has been determined to be the appropriate design flood. Thus the capacity of this dam is considered adequate. The dam will hold a 1 percent probability flood without overtopping.

Data for the 50 percent PMF, the 65 percent PMF, and the 100 percent PMF is presented in the table below.

Percent PMF	Starting Pool Elevation (MSL)	Peak Inflow To Lake (cfs)	Maximum Pool Elevation (MSL)	Maximum Depth Over Dam (feet)	Peak Discharge (Top of Dam) (cfs)	Overtopping Duration (hour)
50%	401.3	242	403.88	0	0	0
65%	401.5	315	404.74	0	0	0
100%	402.6	485	405.48	0.58	167	8+

The starting pool elevations shown were found by assuming the lake level was at the apparent high water mark of 400.0 and then applying an appropriate antecedent storm to the watershed 4 days prior to the storm being analyzed. The antecedent storm for the 50% PMF was a 25% PMF, the antecedent storm for the 65% PMF was a 32% PMF, and the antecedent storm for the 100% PMF was a 50% PMF. All of the inflow to the lake from the antecedent storms is stored in the lake and results in the starting elevations above the apparent high water mark for the analysis of each of the PMF ratio storms.

The small upstream ponds in the watershed were considered to be negligible in the determination of the overtopping percentage of the PMF. When the water level of each of the ponds is at its respective outflow elevation, any inflow to the ponds discharges to Hilltop Fishing Lake. Since the overtopping percentage of the dam depends only on storage and the ponds do not affect the quantity of inflow, they are negligible to the overtopping analysis. The possibility of failure of the small pond dams due to overtopping is very small because they have almost no drainage area other than their respective water surface elevations.

It should be noted that the level of the lake in the past has been controlled by rainfall, runoff, pumping of water from the well upstream of the lake, evaporation, and seepage of water into the groundwater table. The dam has the ability to store a flood in the magnitude of the 65% PMF when the lake level before the spillway design flood is at elevation 401.5. Should the lake level reach an elevation greater than 401.5, the percentage of the PMF that it will be able to hold will be less than 65%. It should be realized that as the elevation of the lake increases, the magnitude of the storm that the dam will hold decreases. As the lake elevation increases, there is an increased chance of overtopping of the dam and its potential failure.

The lake level should be closely monitored when pumping from the well is taking place. The pump should not be allowed to raise the level of the lake more than a foot above the apparent high water mark of 400.0 so that the dam will be able to hold the recommended Spillway Design Flood of 50% of the PMF and its appropriate antecedent storm. It is recommended that the lake level be kept at or below the high water mark of 400.0.

Overtopping of Hilltop Fishing Lake Dam could cause serious erosion and could possibly lead to failure of the structure. Flood discharges resulting from a failure of Hilltop Fishing Lake Dam could be expected to produce substantial stage rises in the hazard zone. Overtopping would lead to potential extensive economic damage in the hazard zone.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Section 3 of this inspection report.

B. Design and Construction Data:

No design data were recorded for this dam. The design considerations taken into account during the construction of the dam were related by Mr. Tom Powers and are presented in Paragraph 1.2 G.

C. Operating Records:

There is no operating equipment at the dam. No records have been kept on the operation of the pump at the well located upstream of the dam.

D. Post-Construction Changes:

No post-construction changes have been made at the dam.

E. Seismic Stability:

This dam is located in or near Seismic Zone 3 as shown on the Seismic Zone Map shown on Plate 3 of Appendix A. Zone 3 delineates areas in which major damage would result from the expected seismic activity in this area. An accurate slope stability analysis with seismic loading cannot be made because of the lack of original design data and soil strength parameters. It should be noted that slopes of the embankment vary and some are relatively steep. In addition, severe erosion has occurred on both the upstream and downstream faces of the embankment. Due to the aforementioned factors, in the event of potential seismic loading, some of the slopes may become unstable and suffer damage, possibly severe.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

A. Safety:

Several items were noticed during the field inspection that could adversely affect the safety of the dam. These items include: (1) erosion due to surface runoff on the upstream and downstream faces of the dam which is severe in several locations; (2) serious shoreline erosion due to wave action; (3) the presence of numerous animal holes on the embankment; and (4) the poor vegetal cover on the dam. These problems, if allowed to continue, might possibly lead to structural instability of the dam.

Another deficiency was the lack of seepage and stability analyses records. This deficiency should be corrected, especially in light of the varying and sometimes steep slopes and the fact that the dam is in or near Seismic Zone 3.

The dam will be overtopped by inflows in excess of approximately 65 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. Since the potential for erosion of the soil type of which the embankment is constructed is high, the potential for failure of this dam should overtopping occur is great.

The dam has no spillway and water is sometimes pumped into the lake from a well. If the pump operation is not monitored the lake level might inadvertently rise to an unsafe level without the occurrence of any rainfall and possibly could overtop the dam.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by Mr. Tom Powers, visual observation of external conditions, and data from available mapping. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the Recommended Guidelines for Safety Inspection of Dams were not available which is considered a deficiency.

C. Urgency:

The remedial measures recommended in Paragraph 7.2 for items concerning the safety of the dam noted in Paragraph 7.1A should be accomplished in the near future. The deficiencies concerning the erosion and burrowing animals should be given a high priority.

D. Necessity for Additional Inspection:

Based on the results of the Phase I inspection, additional periodic inspections are recommended.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Recommendations:

1. A seepage and stability analysis comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams. Since the dam is located in or near Seismic Zone 3, the analysis should include seismic loadings.

2. The embankment slopes may be significantly affected by potential seismic loadings. Provisions should be made to properly stabilize the embankment slopes to prevent potential instability. Such work should be accomplished based upon the engineering analyses recommended in Item 1 above.

B. Operation and Maintenance Procedures:

1. Erosion gullies on the dam should be repaired and reseeded.

2. Animal holes on the dam should be filled and any burrowing animals found on the dam should be removed or destroyed.

3. The shoreline erosion should be repaired.

4. Means should be provided to control future erosion. It is recommended that a better vegetal cover be promoted and shoreline protection from wave erosion may need to be provided.

5. The lake level should be closely monitored when water is being pumped from the well so that the flood storage capacity of the lake is not reduced below the minimum desired. It is recommended that the lake level be kept at or below the current high water mark at elevation 400.0. However, if the lake level is maintained at an elevation of higher than 400.0, a spillway adequate to pass 50 percent of the Probable Maximum Flood will be required.

6. The dam should be periodically inspected by an experienced engineer and records kept of these inspections and maintenance efforts.

PHASE I INSPECTION REPORT

APPENDIX A

MAPS AND GENERAL DRAWINGS

APPENDIX A

MAPS AND GENERAL DRAWINGS

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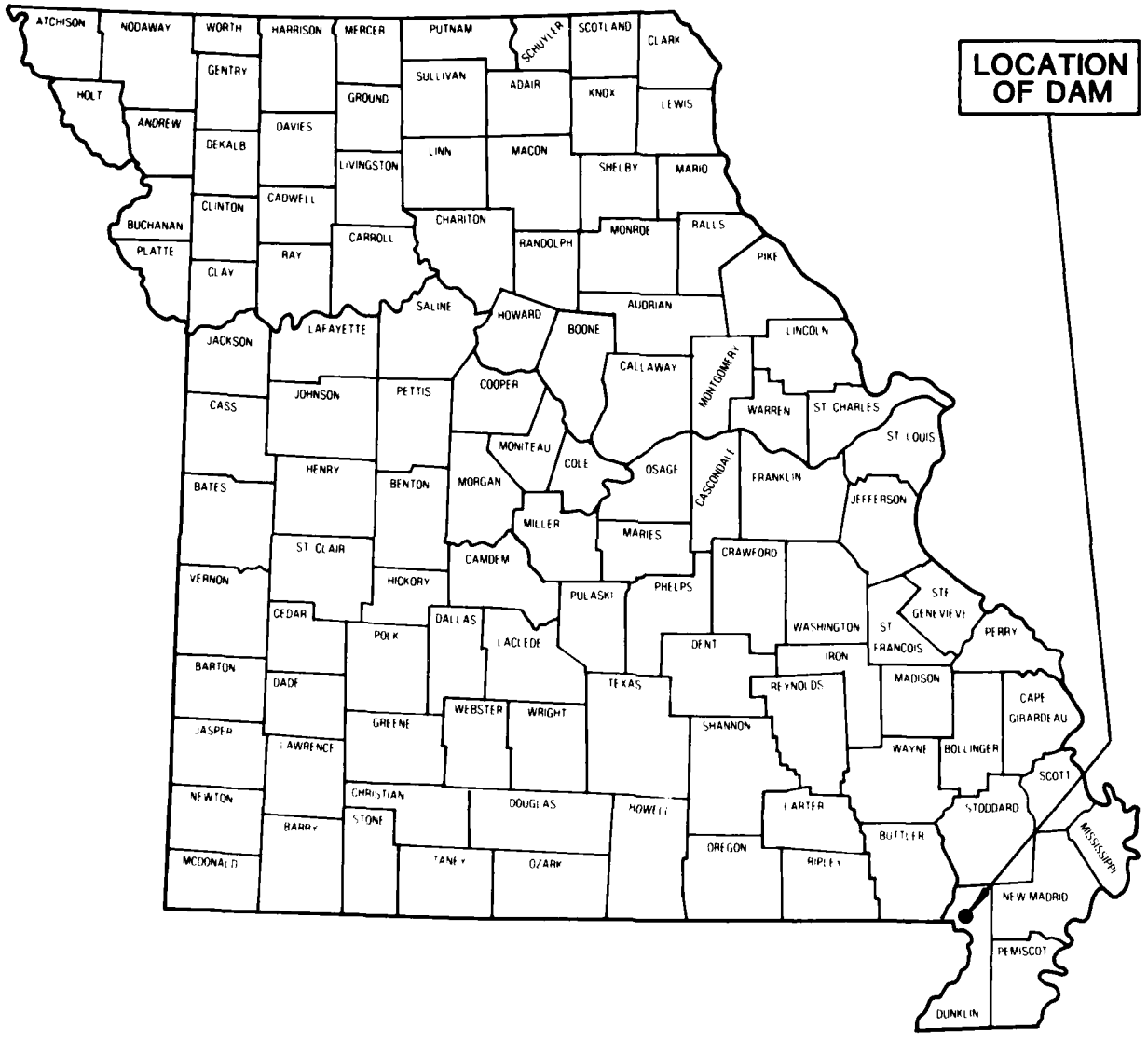

PLATE 1

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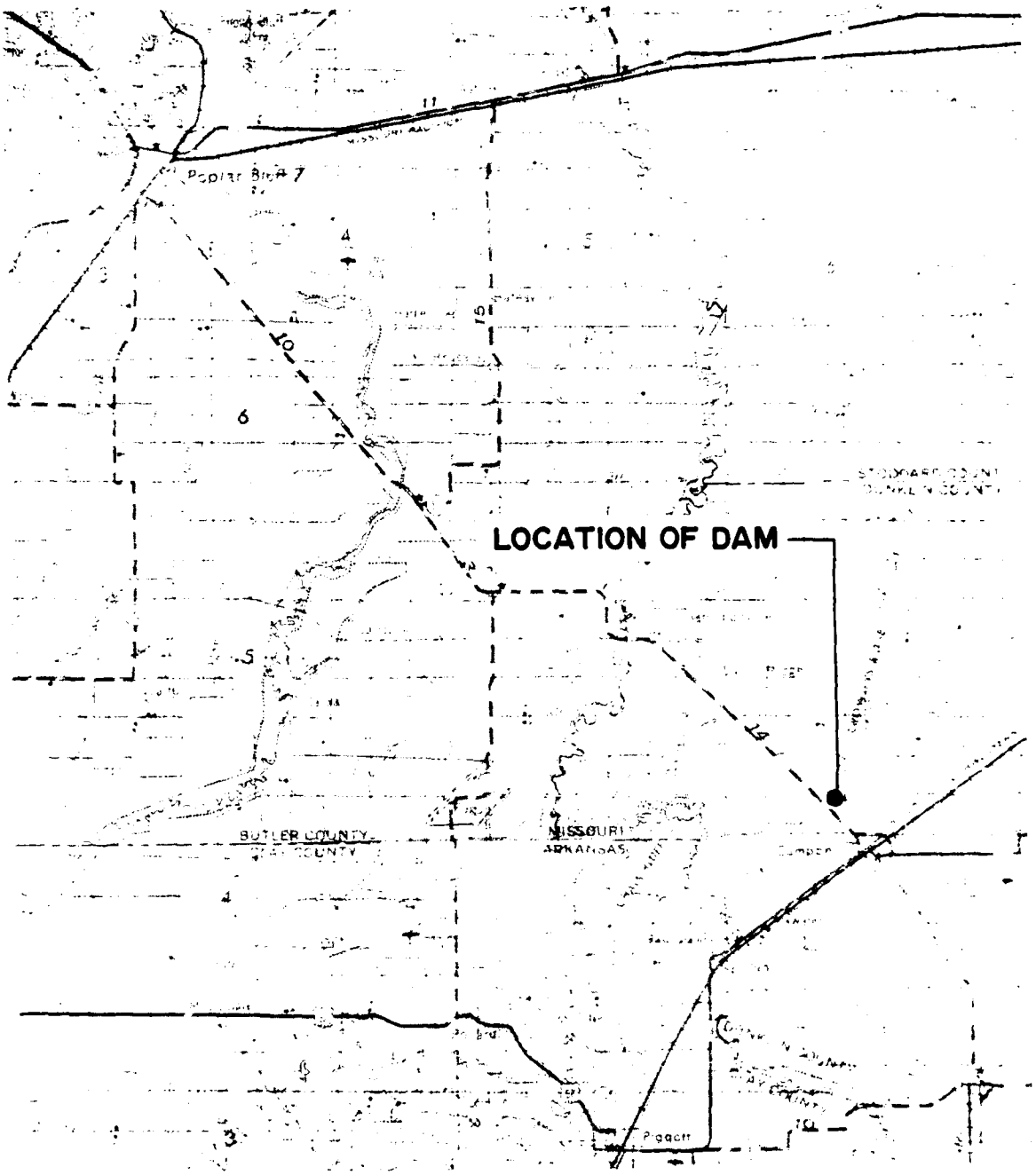
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

LOCATION MAP

HILLTOP FISHING LAKE DAM MO40064



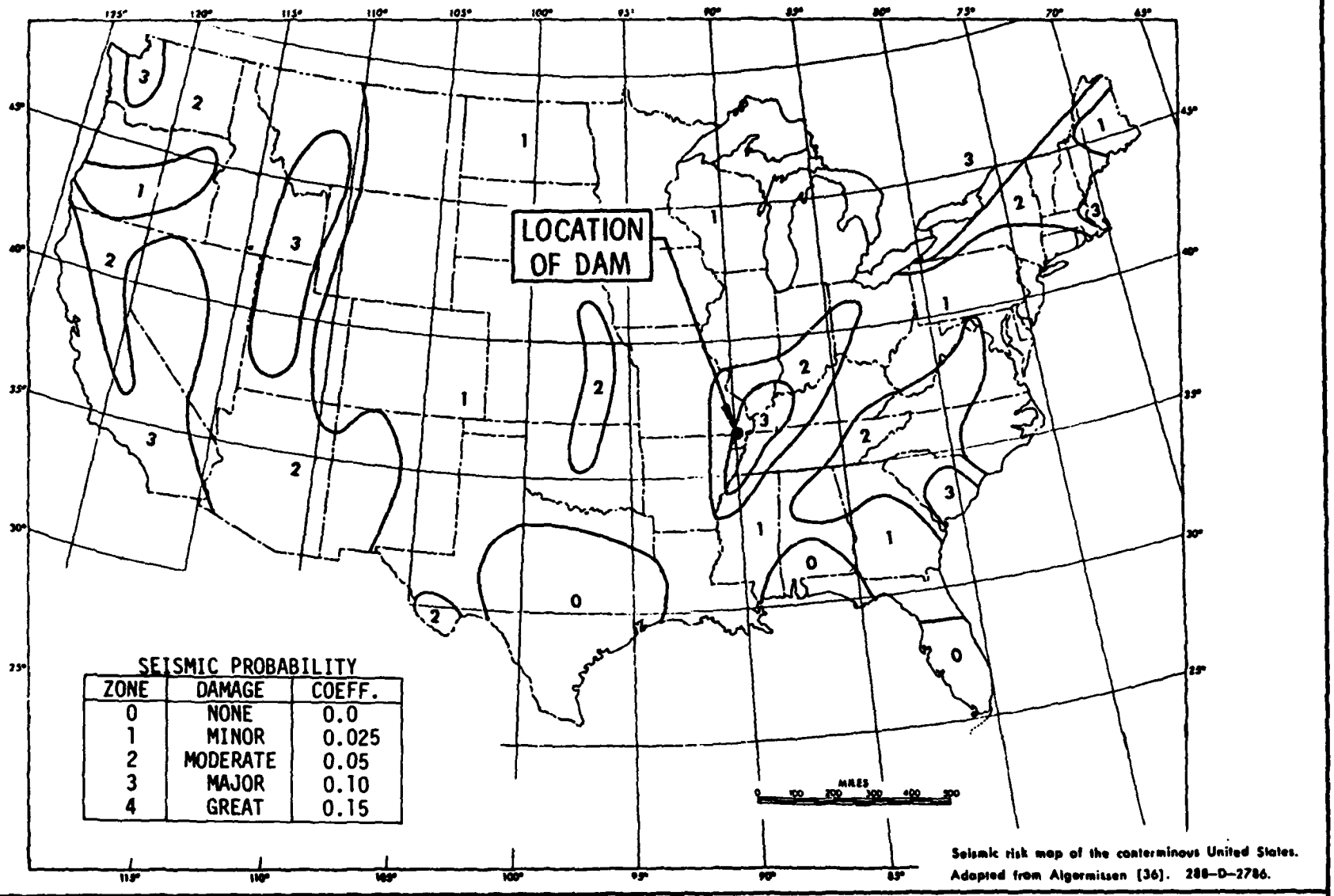
N

SCALE
1:250,000

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

VICINITY MAP
HILLTOP FISHING LK. DAM MO40064

PLATE 2



Seismic risk map of the conterminous United States. Adapted from Algermissen [36]. 288-D-2786.

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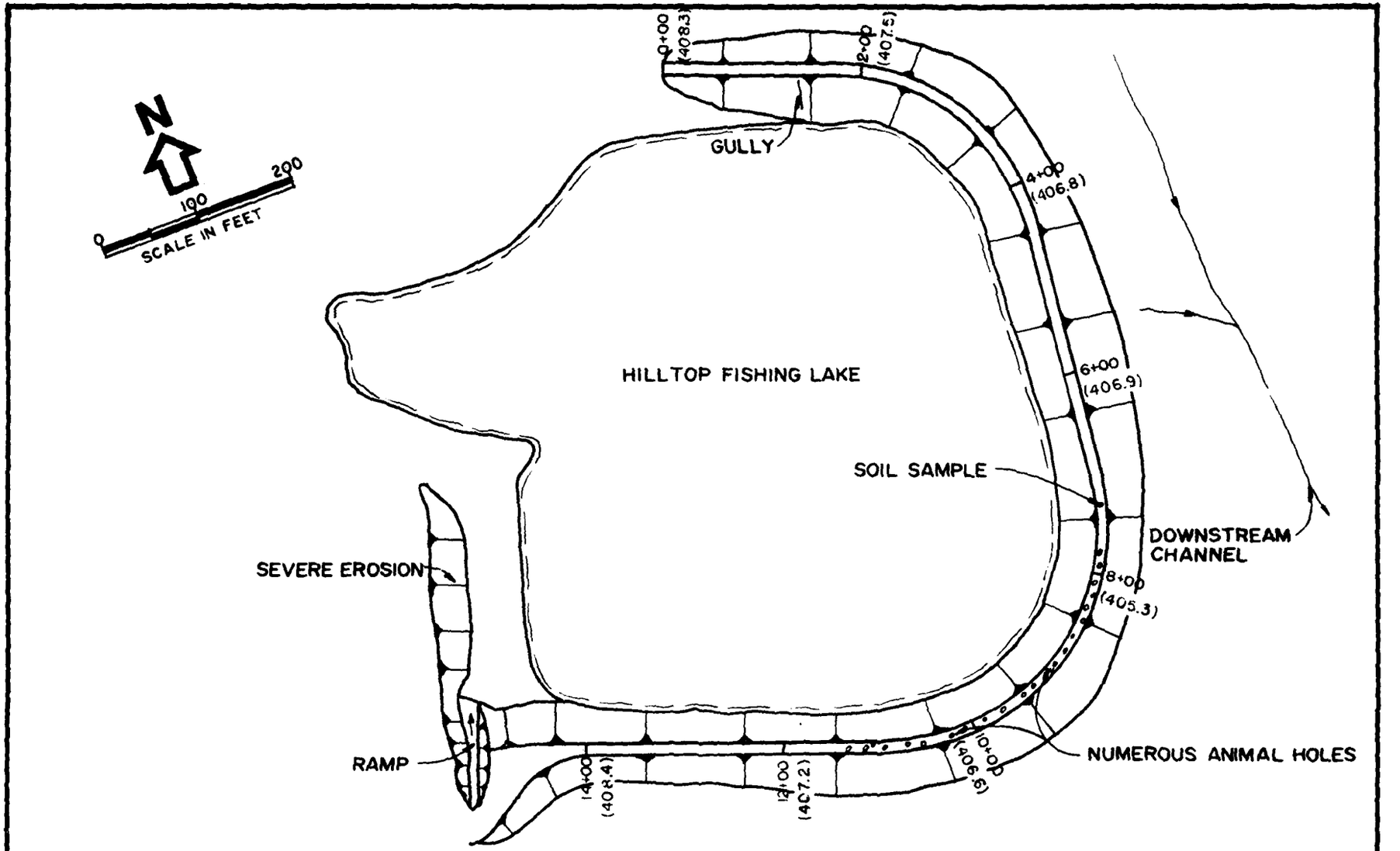
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

SEISMIC ZONE MAP OF CONTIGUOUS STATES
HILLTOP FISHING LAKE DAM

PLATE 3



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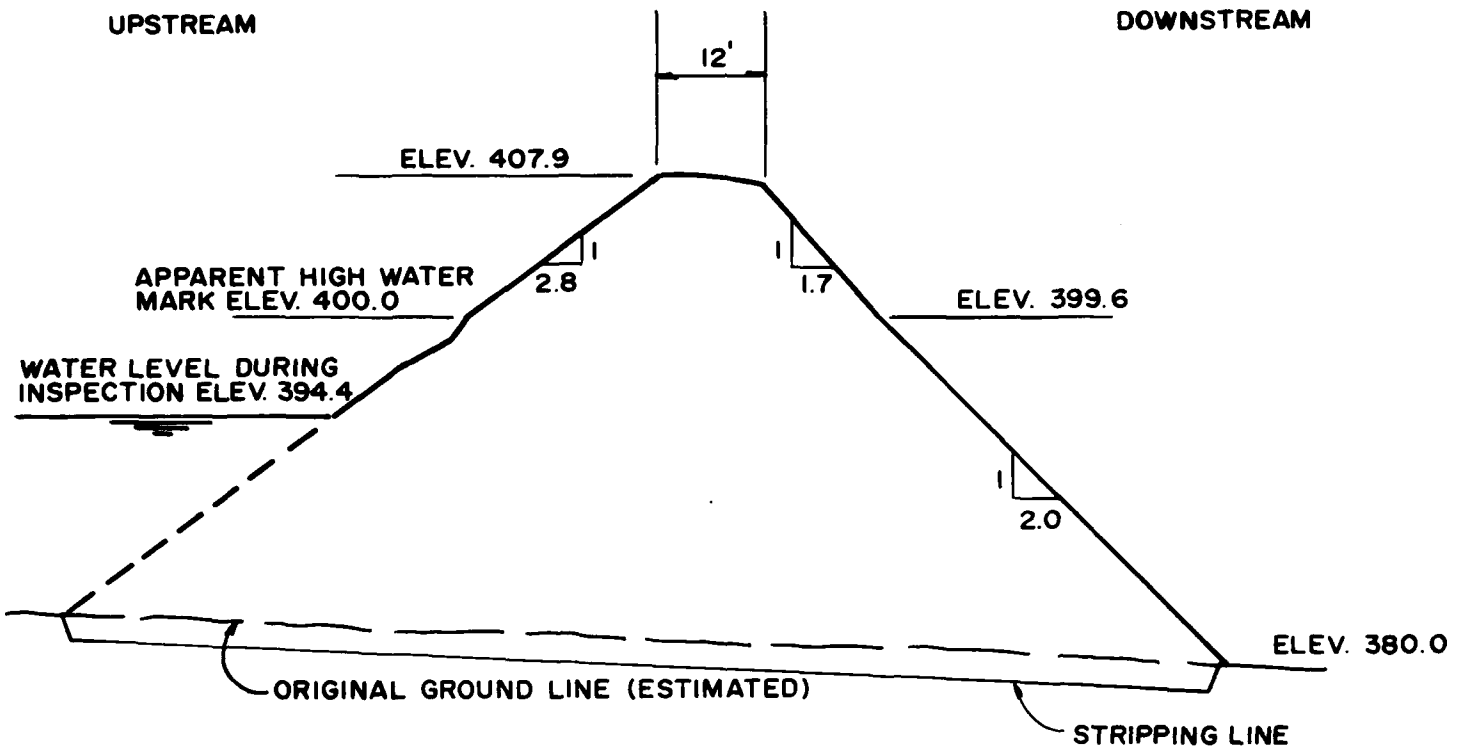
PLAN OF DAM AND LAKE
HILLTOP FISHING LAKE DAM MO40064

PLATE 4

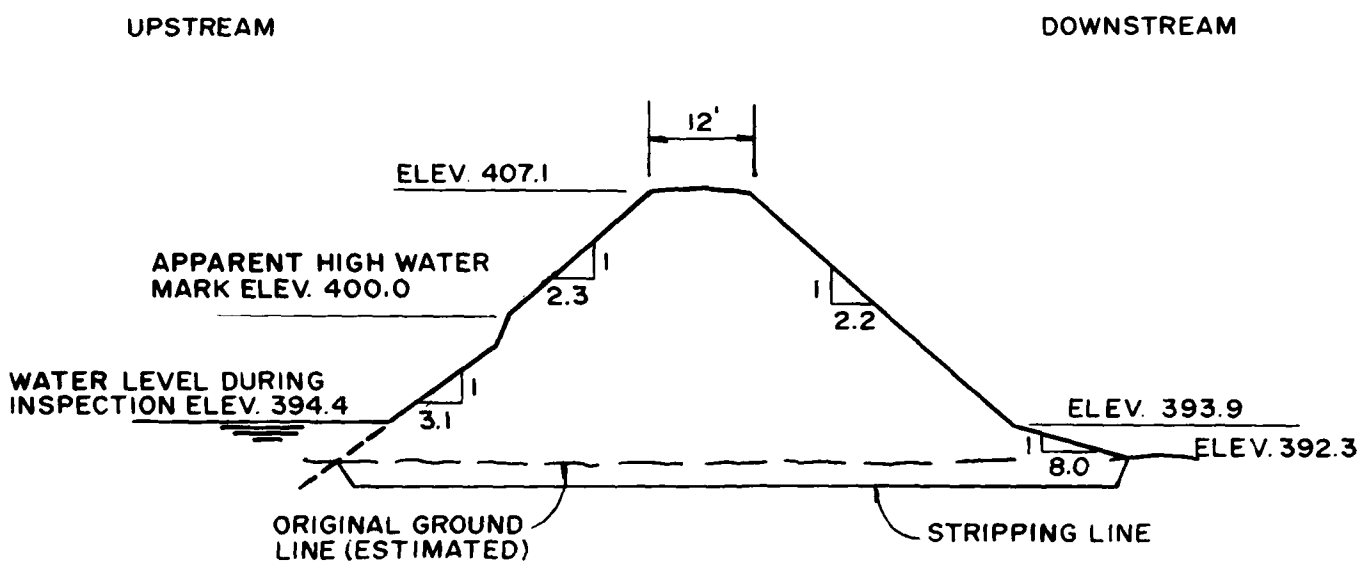


TYPICAL CROSS SECTION OF DAM AT STA. 5+60

APPROXIMATE SCALE
HORIZ. 1" = 20'
VERT. 1" = 10'

PLATE 5

CRAWFORD, MURPHY & TILLY, inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	CROSS SECTION OF DAM HILLTOP FISHING LAKE DAM MO40064



TYPICAL CROSS SECTION AT STA. 11+00

APPROXIMATE SCALE
HORIZ. 1" = 20'
VERT. 1" = 10'

PLATE 6

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PHASE I INSPECTION REPORT

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

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EXHIBITS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

A. PURPOSE:

The purpose of this Appendix is to present the methodology used and the results of the hydrologic and hydraulic analysis. The analysis was done according to criteria presented in the Recommended Guidelines for Safety Inspection of Dams and in the St. Louis District Hydrologic/ Hydraulic Standards for Phase I Safety Inspection of Non-Federal Dams dated 22 August 1980. The purpose of the analysis is to determine the overtopping potential for Hilltop Fishing Lake Dam.

B. HYDROLOGIC AND HYDRAULIC ANALYSIS:

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. Data for determination of the unit hydrograph was obtained from the U.S. Geological Survey 15 minute quadrangle map for Valley Ridge, Missouri dated 1956, and from the field survey. A lake and watershed map is shown on Exhibit 1. The parameters used in the development of the unit hydrograph are presented in Table 1.

The small upstream ponds in the watershed were considered to be negligible in the determination of the overtopping percentage of the PMF. When the water level of each of the ponds is at its respective outflow elevation, any inflow to the ponds discharges to Hilltop Fishing Lake. Since the overtopping percentage of the dam depends only on storage and the ponds do not affect the quantity of inflow, they are negligible to the overtopping analysis. The possibility of failure of the small pond dams due to overtopping is very small because they have almost no drainage area other than their respective water surface elevations. These ponds also had only a minor effect on the unit hydrograph determination and were neglected for this analysis.

TABLE 1

UNIT HYDROGRAPH PARAMETERS

Drainage Area (A)	0.023 sq. miles
Length of Watercourse (L)	0.085 miles
Difference in Elevation (H)	15 feet
Time of Concentration (Tc)	0.05 hours
Lag Time (Lg)	0.03 hours
Time to Peak (Tp)	0.07 hours
Peak Discharge (Qp)	159
Duration (D) (smallest HEC-1 allows)	0.08 hours (5 minutes)

HEC-1 Unit Hydrograph

Time (Minutes)	Discharge (cfs)
0	0
5	135
10	38
15	7
20	1
25	0

Formula Used:

$$Tc = \left[\frac{11.9\ L^3}{H}\right]0.385$$ From "Design of Small Dams," 1973 (Tc verified by overland flow time plus channel flow time)

$$Lg = 0.6\ Tc$$

$$Tp = \frac{D}{2} + Lg$$

$$Qp = \frac{484\ A.Q}{Tp}$$ Q = Excess Runoff = 1 inch

The hypothetical storm that is applied to the unit hydrograph is the Probable Maximum Precipitation (PMP). It is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." No reduction factors have been applied to the PMP. A 24 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions. Soil information was obtained from mapping available from the Dunklin County Soil Conservation Service and land use and slopes were determined from the field inspection and available mapping. This information is presented in Section 3 of this report. Antecedent Moisture Condition III (AMC III) was used for the analysis of the PMP percentage storms. The rainfall applied, the parameters used to determine infiltration losses and the resulting runoff are presented in Table 2.

TABLE 2

RAINFALL-RUNOFF PARAMETERS

Selected Storm Event	Storm Duration (hours)	Rainfall (inches)	Runoff (inches)	Losses (inches)
PMP	24	36.40	36.07	0.33

Additional Data:

1. Soil Conservation Service Runoff Curve Number CN = 93 (AMC III) for the PMF ratio storms.

2. Percentage of Drainage Basin Impervious = 63 percent.

The reservoir routing is accomplished by using the Modified Puls routing technique in which the flood hydrograph is routed through lake storage. The hydraulic capacity of the crest of the dam is used as the outlet control in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the top of the dam is defined by an elevation-discharge curve.

The elevation-storage capacity curve was developed by determining lake surface area at various elevations using the data obtained during the field inspection. An elevation-storage capacity curve was computed and then input to the HEC-1 computer program. The elevation-area-capacity data should only be considered as an approximation because of the minimal amount of field data collected. An elevation-area-capacity curve is shown on Exhibit 2.

For the overtopping analysis the top of the dam is the lower of the following elevations: (1) The minimum elevation of embankment as determined by simple field surveys. (2) The lake elevation at which corresponding outflow velocities, as determined from simple hydraulic formula, exceed the suggested maximum permissible mean channel velocities. Since there is no spillway channel, the top of the dam was determined to be 404.9 which is the minimum elevation of the embankment.

The elevation-discharge capacity curve for the top of the dam was developed using the non-level crest option of the HEC-1 computer program. The program assumes critical flow over a broad crested weir and uses the formula $Q = CLH^{1.5}$. The coefficient C was chosen to be 2.6 as found in Handbook of Hydraulics by Horace Williams King and Ernest F. Brater. A profile of the dam crest is given on Exhibit 3.

The dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This analysis determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being effectively overtopped. According to "Hydrologic/Hydraulic Standards" developed by the Corps of Engineers, St. Louis District, an antecedent storm should be applied to the watershed before analysis of the PMF. The antecedent storm precedes the storm being analyzed by 4 days and the starting elevation at the beginning of the antecedent storm is the mean annual high water mark. Since no mean annual high water mark could be determined for Hilltop Fishing Lake, the observed apparent high water mark at elevation 400.0 was used as the starting elevation at the beginning of the antecedent storms. Since Mr. Tom Powers indicated that he usually tried to keep the lake level near elevation 400.0, the apparent high water mark was believed to be a close approximation of the mean annual high water mark. The level of the upstream ponds were assumed to be at their respective spillway crest elevations. Therefore, all of the run-off into the ponds overflowed into the lake. The antecedent storm for the analysis of the PMF ratio storms is one-half the storm being analyzed. There is enough storage capacity between the apparent high water mark elevation and the top of dam elevation that all of the antecedent storms can be stored. The starting elevations, antecedent storms, and storms analyzed are given in Table 3.

TABLE 3

ANTECEDENT STORMS AND STARTING ELEVATIONS

Starting Elevation Before Antecedent Storm	Antecedent Storm Used	Elevation at Start of Storm Being Analyzed	Storm Being Analyzed
400.0	25% PMF	401.3	50% PMF
400.0	32% PMF	401.5	65% PMF
400.0	50% PMF	402.6	100% PMF

The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site for the 50% PMF and for the identification of the overtopping percentage of the PMF and input to the program are listed on Exhibits 4 and 5. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow for the 50% PMF and 65% PMF are presented on Exhibits 6 and 7 respectively. There is no outflow from the lake for the 50% PMF and 65% PMF. The inflow and outflow for the 100% PMF are presented on Exhibit 8. The summary tables for the 50% PMF, identification of the overtopping percentage of the PMF, and the 100% PMF are presented on Exhibits 9, 10 and 11 respectively.

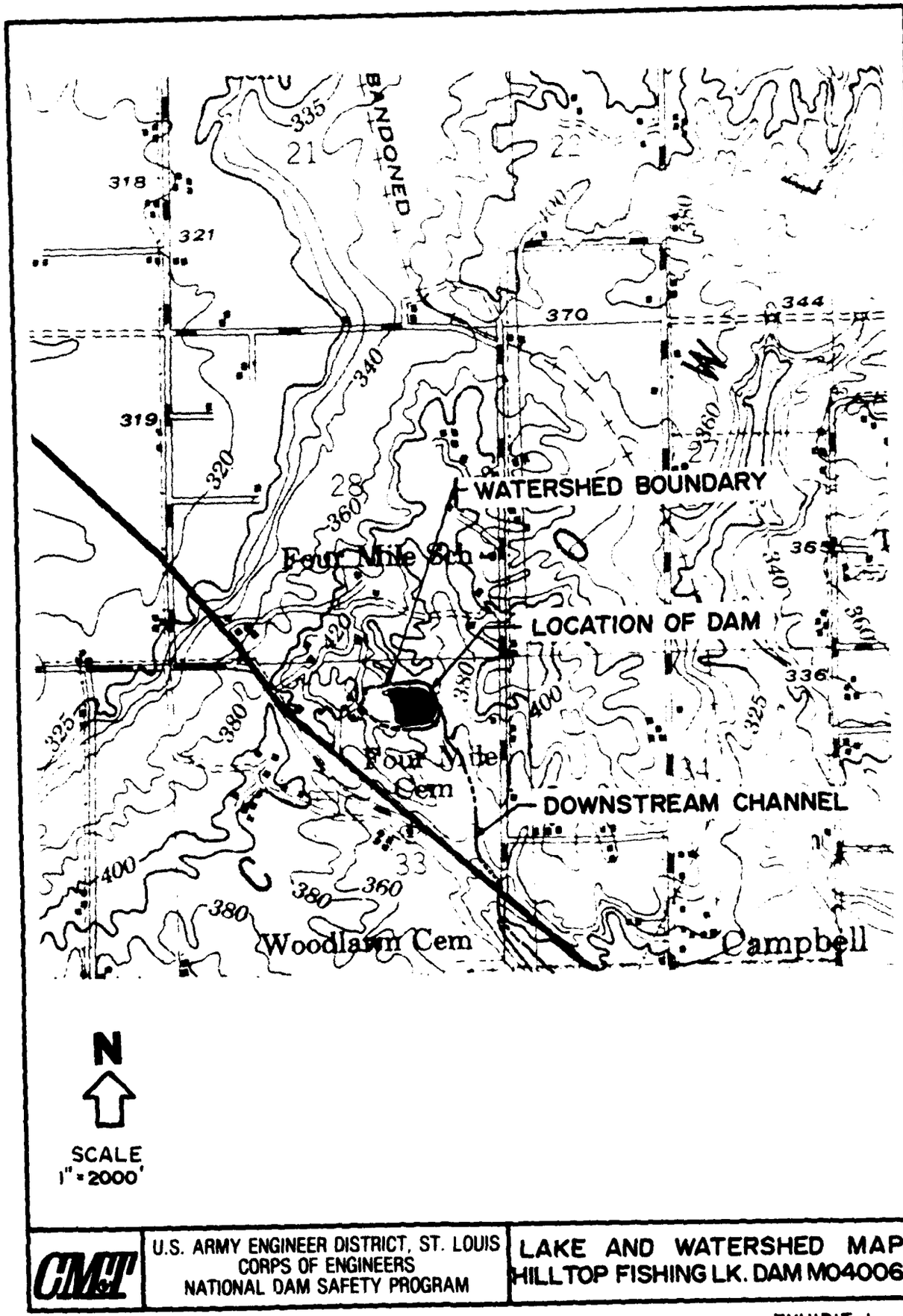
C. REFERENCES:

a. Design of Small Dams, United States Department of the Interior, Bureau of Reclamation, Second Edition, 1973.

b. Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations, The Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California; September, 1978.

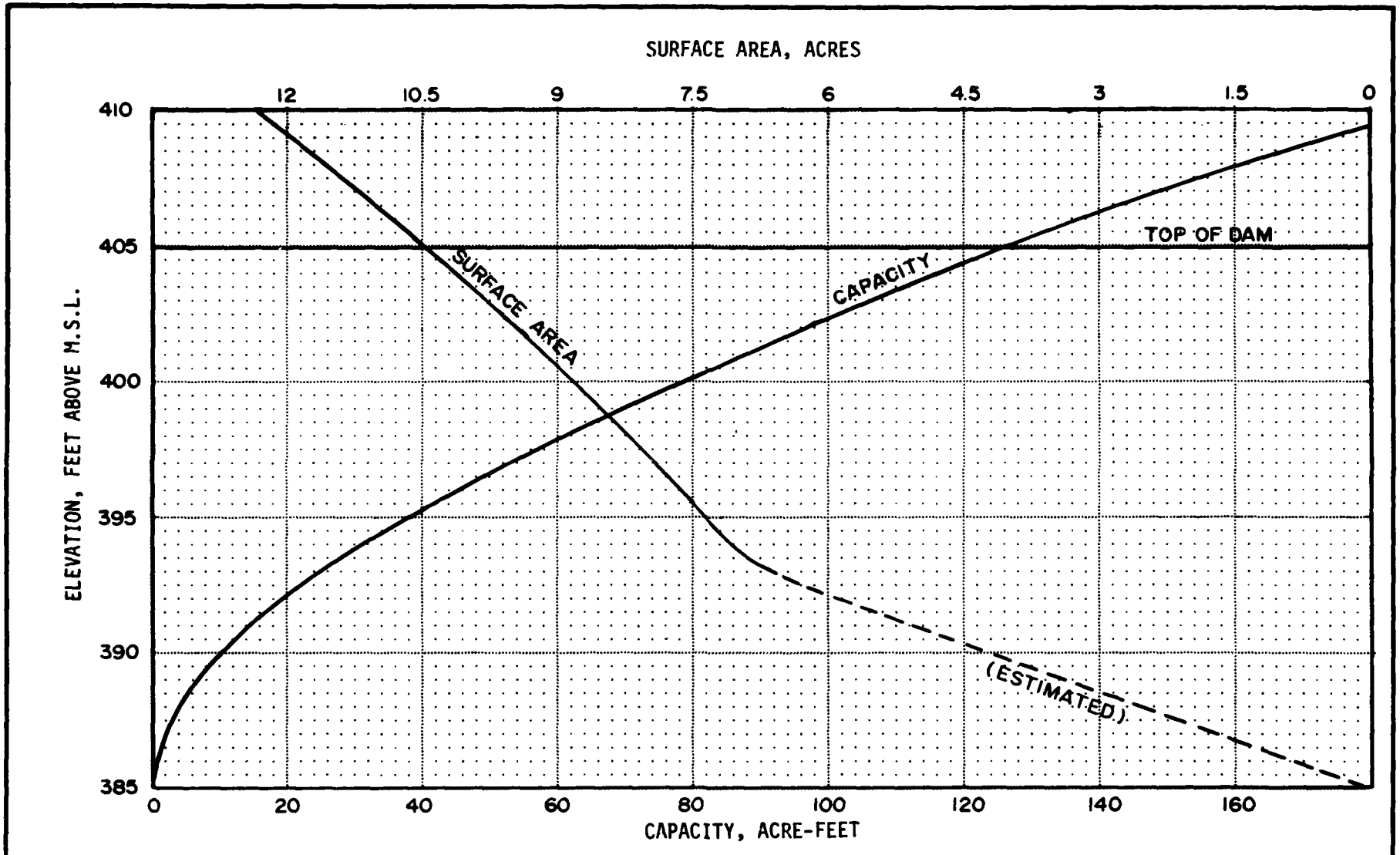
c. King, Horace Williams, Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, 1963.

d. Riedel, J. T., Appleby, J. F., and Schloemer, R. W., Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24 and 48 Hours, Hydrometeorological Report No. 33, U.S. Department of Commerce, Weather Bureau, April 1956.



CMST	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	LAKE AND WATERSHED MAP HILLTOP FISHING LK. DAM MO40064

EXHIBIT 1



CRAWFORD, MURPHY & TILLY, Inc. Consulting Engineers
SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

ELEVATION - AREA - CAPACITY RELATION
HILLTOP FISHING LAKE DAM MO40064

EXHIBIT 2

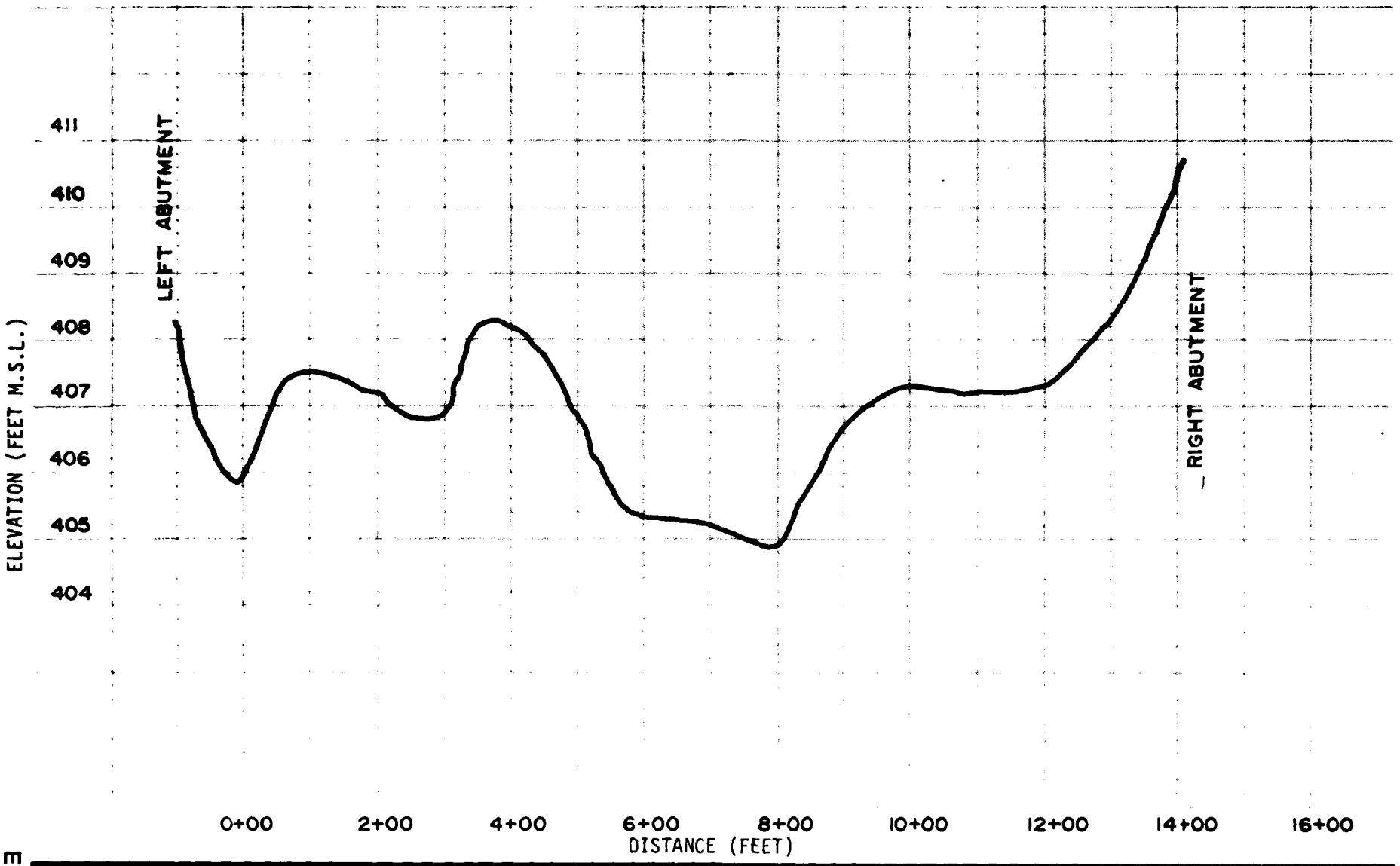


EXHIBIT 3

CLAYTOR, HUDSPETH & TILLEY, Inc. Consulting Engineers
SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

PROFILE OF CREST
HILLTOP FISHING LAKE DAM MO40064

CM&T

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INPUT DATA, 50% PMF
HILLTOP FISHING LAKE DAM
MO40064

EXHIBIT 4

```
A1 HYDROLOGIC/HYDRAULIC ANALYSIS -- HILLTOP FISHING LAKE DAM(MO40064) DUNKLIN,CO
A2 NATIONAL DAM SAFETY PROGRAM -- CORPS OF ENGINEERS, ST. LOUIS DISTRICT
A3 CM&T JOB NO. 8034-02        FEBRUARY 4, 1981
B     288       0       5                                          0       0      -2
B1      5
J       1       1       1
J1   0.50
K       0  INFLOW                                                  1
K1 INFLOW HYDROGRAPH COMPUTATION FOR 50% PMF
M       1       2  0.0234                          1                              1
P       0    28.0     102     120     130
T                                                                -1     -93              0.63
W2           0.03
X       0    -0.1    1.75
K       1    LAKE                                                1
K1 RESERVOIR ROUTING BY MODIFIED PULS METHOD
Y                                       1       1
Y1      1                                                -401.3      -1
Y4  404.9     407     410
Y5      0       0       0
$S      0     3.7    10.4    19.6    31.7    46.4    79.2   117.0   160.4
$E    385     388     390     392     394     396     400     404     408
$$  404.9
$D  404.9     2.6     1.5    1500
$L      0     230     310     510    1010    1180    1410
$V  404.9   405.3   405.9   406.8   407.3   407.5   408.3
K      99
A
```

CM&T

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INPUT DATA, IDENTIFICATION OF OVERTOPPING PERCENTAGE OF PMF
HILLTOP FISH'G LAKE DAM MO40064

```
A1 HYDROLOGIC/HYDRAULIC ANALYSIS -- HILLTOP FISHING LAKE DAM(MO40064) DUNKLIN,CO
A2 NATIONAL DAM SAFETY PROGRAM -- CORPS OF ENGINEERS, ST. LOUIS DISTRICT
A3 CM&T JOB NO. 8034-02        FEBRUARY 4, 1981
B     288       0       5                                          0       0      -2
B1      5
J       1       3       1
J1   0.60    0.65    0.70
K       0  INFLOW                                                  1
K1 INFLOW HYDROGRAPH COMPUTATION FOR OVERTOPPING % OF PMF
M       1       2  0.0234                                    1                      1
P       0    28.0     102     120     130
T                                                              -1      -93              0.63
W2           0.03
X       0    -0.1    1.75
K       1    LAKE                                              1
K1 RESERVOIR ROUTING BY MODIFIED PULS METHOD
Y                                    1       1
Y1      1                                                -401.5      -1
Y4  404.9     407     410
Y5      0       0       0
$S      0     3.7    10.4    19.6    31.7    46.4    79.2   117.0   160.4
$E    385     388     390     392     394     396     400     404     408
$$  404.9
$D  404.9     2.6     1.5    1500
$L      0     230     310     510    1010    1180    1410
$V  404.9   405.3   405.9   406.8   407.3   407.5   408.3
K      99
A
```

EXHIBIT 5

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 1

1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	32.	32.	65.	30.	24.	19.	11.	6.	4.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	31.	32.	86.	30.	24.	20.	11.	7.	4.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	26.	32.	145.	30.	24.	21.	12.	7.	4.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	25.	26.	32.	242.	30.	24.	22.	13.	7.	4.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	22.	26.	32.	141.	30.	24.	24.	14.	8.	4.	3.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	18.	21.	26.	32.	65.	30.	25.	24.	14.	8.	5.	3.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	32.	54.	31.	30.	24.	15.	9.	5.	3.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	5.	6.	6.	6.	6.	6.	21.	26.	32.	38.	33.	30.	24.	16.	9.	5.	3.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	32.	35.	40.	30.	24.	17.	10.	6.	3.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	6.	6.	6.	6.	6.	6.	21.	26.	32.	23.	45.	30.	24.	18.	10.	6.	3.	2.	2.	2.

CMS	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	INFLOW 50% PMF HILLTOP FISHING LAKE DAM MO40064

EXHIBIT 6

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 2

1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	34.	42.	42.	84.	39.	31.	25.	14.	8.	5.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	34.	40.	42.	112.	39.	31.	26.	15.	9.	5.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	33.	34.	42.	188.	39.	31.	28.	16.	9.	5.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	32.	34.	42.	315.	39.	31.	29.	17.	10.	5.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	27.	28.	34.	42.	183.	39.	31.	31.	18.	10.	6.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	23.	28.	34.	42.	85.	39.	33.	31.	19.	11.	6.	3.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	7.	8.	8.	8.	8.	8.	8.	28.	34.	42.	70.	40.	39.	31.	30.	20.	11.	6.	4.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	6.	8.	8.	8.	8.	8.	8.	28.	34.	42.	50.	42.	39.	31.	31.	21.	12.	7.	4.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	34.	42.	45.	52.	39.	31.	31.	22.	13.	7.	4.	3.	3.
1.	1.	1.	2.	2.	2.	2.	2.	8.	8.	8.	8.	8.	8.	8.	28.	34.	42.	42.	59.	39.	31.	31.	23.	13.	8.	4.	3.	3.

CM&T	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	INFLOW 65% PMF HILLTOP FISHING LAKE DAM MO40064

EXHIBIT 7

END-OF-PERIOD HYDROGRAPH ORDINATES								END-OF-PERIOD HYDROGRAPH ORDINATES							
MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE	MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.05	1	.08	1.	0.	104.	402.6	1.01	12.05	145	12.08	35.	0.	111.	403.4
1.01	.10	2	.17	2.	0.	104.	402.6	1.01	12.10	146	12.17	41.	0.	111.	403.4
1.01	.15	3	.25	2.	0.	104.	402.6	1.01	12.15	147	12.25	43.	0.	112.	403.4
1.01	.20	4	.33	2.	0.	104.	402.6	1.01	12.20	148	12.33	43.	0.	112.	403.5
1.01	.25	5	.42	2.	0.	104.	402.6	1.01	12.25	149	12.42	43.	0.	112.	403.5
1.01	.30	6	.50	2.	0.	104.	402.6	1.01	12.30	150	12.50	43.	0.	113.	403.5
1.01	.35	7	.58	2.	0.	104.	402.6	1.01	12.35	151	12.58	43.	0.	113.	403.6
1.01	.40	8	.67	2.	0.	104.	402.6	1.01	12.40	152	12.67	43.	0.	113.	403.6
1.01	.45	9	.75	2.	0.	104.	402.6	1.01	12.45	153	12.75	43.	0.	113.	403.6
1.01	.50	10	.83	2.	0.	104.	402.6	1.01	12.50	154	12.83	43.	0.	114.	403.7
1.01	.55	11	.92	2.	0.	104.	402.6	1.01	12.55	155	12.92	43.	0.	114.	403.7
1.01	1.00	12	1.00	2.	0.	104.	402.6	1.01	13.00	156	13.00	43.	0.	114.	403.7
1.01	1.05	13	1.08	2.	0.	104.	402.6	1.01	13.05	157	13.08	49.	0.	115.	403.8
1.01	1.10	14	1.17	2.	0.	104.	402.6	1.01	13.10	158	13.17	51.	0.	115.	403.8
1.01	1.15	15	1.25	2.	0.	104.	402.6	1.01	13.15	159	13.25	52.	0.	115.	403.8
1.01	1.20	16	1.33	2.	0.	104.	402.6	1.01	13.20	160	13.33	52.	0.	116.	403.9
1.01	1.25	17	1.42	2.	0.	104.	402.6	1.01	13.25	161	13.42	52.	0.	116.	403.9
1.01	1.30	18	1.50	2.	0.	104.	402.6	1.01	13.30	162	13.50	52.	0.	116.	403.9
1.01	1.35	19	1.58	2.	0.	104.	402.6	1.01	13.35	163	13.58	52.	0.	117.	404.0
1.01	1.40	20	1.67	2.	0.	104.	402.6	1.01	13.40	164	13.67	52.	0.	117.	404.0
1.01	1.45	21	1.75	2.	0.	104.	402.6	1.01	13.45	165	13.75	52.	0.	117.	404.0
1.01	1.50	22	1.83	2.	0.	104.	402.6	1.01	13.50	166	13.83	52.	0.	118.	404.1
1.01	1.55	23	1.92	2.	0.	104.	402.6	1.01	13.55	167	13.92	52.	0.	118.	404.1
1.01	2.00	24	2.00	2.	0.	104.	402.6	1.01	14.00	168	14.00	52.	0.	119.	404.1
1.01	2.05	25	2.08	2.	0.	104.	402.6	1.01	14.05	169	14.08	61.	0.	119.	404.2
1.01	2.10	26	2.17	2.	0.	104.	402.6	1.01	14.10	170	14.17	64.	0.	119.	404.2
1.01	2.15	27	2.25	2.	0.	104.	402.6	1.01	14.15	171	14.25	64.	0.	120.	404.3
1.01	2.20	28	2.33	2.	0.	104.	402.6	1.01	14.20	172	14.33	65.	0.	120.	404.3
1.01	2.25	29	2.42	2.	0.	104.	402.6	1.01	14.25	173	14.42	65.	0.	121.	404.3
1.01	2.30	30	2.50	2.	0.	104.	402.6	1.01	14.30	174	14.50	65.	0.	121.	404.4
1.01	2.35	31	2.58	2.	0.	104.	402.6	1.01	14.35	175	14.58	65.	0.	122.	404.4
1.01	2.40	32	2.67	2.	0.	104.	402.6	1.01	14.40	176	14.67	65.	0.	122.	404.5
1.01	2.45	33	2.75	2.	0.	104.	402.6	1.01	14.45	177	14.75	65.	0.	122.	404.5
1.01	2.50	34	2.83	2.	0.	104.	402.6	1.01	14.50	178	14.83	65.	0.	123.	404.5
1.01	2.55	35	2.92	2.	0.	104.	402.7	1.01	14.55	179	14.92	65.	0.	123.	404.6
1.01	3.00	36	3.00	2.	0.	104.	402.7	1.01	15.00	180	15.00	65.	0.	124.	404.6
1.01	3.05	37	3.08	2.	0.	104.	402.7	1.01	15.05	181	15.08	46.	0.	124.	404.7
1.01	3.10	38	3.17	2.	0.	104.	402.7	1.01	15.10	182	15.17	70.	0.	125.	404.7
1.01	3.15	39	3.25	2.	0.	104.	402.7	1.01	15.15	183	15.25	77.	0.	125.	404.7
1.01	3.20	40	3.33	2.	0.	104.	402.7	1.01	15.20	184	15.33	107.	0.	126.	404.8
1.01	3.25	41	3.42	2.	0.	104.	402.7	1.01	15.25	185	15.42	131.	0.	127.	404.9
1.01	3.30	42	3.50	2.	0.	104.	402.7	1.01	15.30	186	15.50	282.	3.	128.	405.0
1.01	3.35	43	3.58	2.	0.	104.	402.7	1.01	15.35	187	15.58	485.	.44.	130.	405.2
1.01	3.40	44	3.67	2.	0.	104.	402.7	1.01	15.40	188	15.67	290.	134.	132.	405.4
1.01	3.45	45	3.75	2.	0.	104.	402.7	1.01	15.45	189	15.75	172.	167.	133.	405.5
1.01	3.50	46	3.83	2.	0.	104.	402.7	1.01	15.50	190	15.83	130.	162.	133.	405.5
1.01	3.55	47	3.92	2.	0.	104.	402.7	1.01	15.55	191	15.92	90.	144.	133.	405.4
1.01	4.00	48	4.00	2.	0.	104.	402.7	1.01	16.00	192	16.00	81.	125.	132.	405.4
1.01	4.05	49	4.08	2.	0.	104.	402.7	1.01	16.05	193	16.08	65.	109.	132.	405.4
1.01	4.10	50	4.17	3.	0.	105.	402.7	1.01	16.10	194	16.17	61.	96.	132.	405.4
1.01	4.15	51	4.25	3.	0.	105.	402.7	1.01	16.15	195	16.25	60.	86.	132.	405.3
1.01	4.20	52	4.33	3.	0.	105.	402.7	1.01	16.20	196	16.33	60.	80.	131.	405.3
1.01	4.25	53	4.42	3.	0.	105.	402.7	1.01	16.25	197	16.42	60.	75.	131.	405.3
1.01	4.30	54	4.50	3.	0.	105.	402.7	1.01	16.30	198	16.50	60.	71.	131.	405.3
1.01	4.35	55	4.58	3.	0.	105.	402.7	1.01	16.35	199	16.58	60.	69.	131.	405.3
1.01	4.40	56	4.67	3.	0.	105.	402.7	1.01	16.40	200	16.67	60.	67.	131.	405.3
1.01	4.45	57	4.75	3.	0.	105.	402.7	1.01	16.45	201	16.75	60.	65.	131.	405.3
1.01	4.50	58	4.83	3.	0.	105.	402.7	1.01	16.50	202	16.83	60.	64.	131.	405.3
1.01	4.55	59	4.92	3.	0.	105.	402.7	1.01	16.55	203	16.92	60.	63.	131.	405.3
1.01	5.00	60	5.00	3.	0.	105.	402.7	1.01	17.00	204	17.00	60.	63.	131.	405.3
1.01	5.05	61	5.08	3.	0.	105.	402.7	1.01	17.05	205	17.08	51.	61.	131.	405.3
1.01	5.10	62	5.17	3.	0.	105.	402.7	1.01	17.10	206	17.17	48.	59.	131.	405.3
1.01	5.15	63	5.25	3.	0.	105.	402.7	1.01	17.15	207	17.25	48.	56.	131.	405.3
1.01	5.20	64	5.33	3.	0.	105.	402.7	1.01	17.20	208	17.33	47.	54.	131.	405.3
1.01	5.25	65	5.42	3.	0.	105.	402.7	1.01	17.25	209	17.42	47.	53.	131.	405.3
1.01	5.30	66	5.50	3.	0.	105.	402.7	1.01	17.30	210	17.50	47.	52.	131.	405.3
1.01	5.35	67	5.58	3.	0.	105.	402.7	1.01	17.35	211	17.58	47.	51.	131.	405.3
1.01	5.40	68	5.67	3.	0.	105.	402.7	1.01	17.40	212	17.67	47.	50.	131.	405.3
1.01	5.45	69	5.75	3.	0.	105.	402.7	1.01	17.45	213	17.75	47.	50.	131.	405.3
1.01	5.50	70	5.83	3.	0.	105.	402.7	1.01	17.50	214	17.83	47.	49.	131.	405.3
1.01	5.55	71	5.92	3.	0.	105.	402.7	1.01	17.55	215	17.92	47.	49.	131.	405.3
1.01	6.00	72	6.00	3.	0.	105.	402.7	1.01	18.00	216	18.00	47.	49.	131.	405.3
1.01	6.05	73	6.08	9.	0.	105.	402.7	1.01	18.05	217	18.08	45.	48.	131.	405.3
1.01	6.10	74	6.17	11.	0.	105.	402.7	1.01	18.10	218	18.17	42.	47.	131.	405.2
1.01	6.15	75	6.25	12.	0.	105.	402.7	1.01	18.15	219	18.25	40.	46.	131.	405.2
[illegible]								1.01	18.20	220	18.33	38.	45.	130.	405.2

1.01	5.50	70	5.83	3.	0.	105.	402.7	1.01	17.50	215	17.92	47.	49.	131.	405.3
1.01	5.55	71	5.92	3.	0.	105.	402.7	1.01	17.55	215	17.92	47.	49.	131.	405.3
1.01	6.00	72	6.00	3.	0.	105.	402.7	1.01	18.00	216	18.00	47.	49.	131.	405.3
1.01	6.05	73	6.08	9.	0.	105.	402.7	1.01	18.05	217	18.08	45.	48.	131.	405.3
1.01	6.10	74	6.17	11.	0.	105.	402.7	1.01	18.10	218	18.17	42.	47.	131.	405.2
1.01	6.15	75	6.25	12.	0.	105.	402.7	1.01	18.15	219	18.25	40.	46.	131.	405.2
1.01	6.20	76	6.33	12.	0.	105.	402.7	1.01	18.20	220	18.33	38.	45.	130.	405.2
1.01	6.25	77	6.42	12.	0.	105.	402.8	1.01	18.25	221	18.42	36.	43.	130.	405.2
1.01	6.30	78	6.50	12.	0.	105.	402.8	1.01	18.30	222	18.50	34.	42.	130.	405.2
1.01	6.35	79	6.58	12.	0.	105.	402.8	1.01	18.35	223	18.58	32.	40.	130.	405.2
1.01	6.40	80	6.67	12.	0.	105.	402.8	1.01	18.40	224	18.67	30.	39.	130.	405.2
1.01	6.45	81	6.75	12.	0.	106.	402.8	1.01	18.45	225	18.75	29.	37.	130.	405.2
1.01	6.50	82	6.83	12.	0.	106.	402.8	1.01	18.50	226	18.83	27.	36.	130.	405.2
1.01	6.55	83	6.92	12.	0.	106.	402.8	1.01	18.55	227	18.92	26.	34.	130.	405.2
1.01	7.00	84	7.00	12.	0.	106.	402.8	1.01	19.00	228	19.00	24.	33.	130.	405.2
1.01	7.05	85	7.08	12.	0.	106.	402.8	1.01	19.05	229	19.08	23.	31.	130.	405.2
1.01	7.10	86	7.17	12.	0.	106.	402.8	1.01	19.10	230	19.17	22.	30.	130.	405.2
1.01	7.15	87	7.25	12.	0.	106.	402.8	1.01	19.15	231	19.25	20.	29.	130.	405.2
1.01	7.20	88	7.33	12.	0.	106.	402.9	1.01	19.20	232	19.33	19.	27.	130.	405.2
1.01	7.25	89	7.42	12.	0.	106.	402.9	1.01	19.25	233	19.42	18.	26.	130.	405.2
1.01	7.30	90	7.50	12.	0.	106.	402.9	1.01	19.30	234	19.50	17.	25.	130.	405.2
1.01	7.35	91	7.58	12.	0.	106.	402.9	1.01	19.35	235	19.58	16.	24.	130.	405.2
1.01	7.40	92	7.67	12.	0.	107.	402.9	1.01	19.40	236	19.67	15.	23.	130.	405.2
1.01	7.45	93	7.75	12.	0.	107.	402.9	1.01	19.45	237	19.75	15.	22.	130.	405.2
1.01	7.50	94	7.83	12.	0.	107.	402.9	1.01	19.50	238	19.83	14.	21.	129.	405.2
1.01	7.55	95	7.92	12.	0.	107.	402.9	1.01	19.55	239	19.92	13.	20.	129.	405.1
1.01	8.00	96	8.00	12.	0.	107.	402.9	1.01	20.00	240	20.00	12.	19.	129.	405.1
1.01	8.05	97	8.08	12.	0.	107.	402.9	1.01	20.05	241	20.08	12.	18.	129.	405.1
1.01	8.10	98	8.17	12.	0.	107.	402.9	1.01	20.10	242	20.17	11.	18.	129.	405.1
1.01	8.15	99	8.25	12.	0.	107.	403.0	1.01	20.15	243	20.25	10.	17.	129.	405.1
1.01	8.20	100	8.33	12.	0.	107.	403.0	1.01	20.20	244	20.33	10.	16.	129.	405.1
1.01	8.25	101	8.42	12.	0.	107.	403.0	1.01	20.25	245	20.42	9.	16.	129.	405.1
1.01	8.30	102	8.50	12.	0.	107.	403.0	1.01	20.30	246	20.50	9.	15.	129.	405.1
1.01	8.35	103	8.58	12.	0.	107.	403.0	1.01	20.35	247	20.58	8.	14.	129.	405.1
1.01	8.40	104	8.67	13.	0.	108.	403.0	1.01	20.40	248	20.67	8.	14.	129.	405.1
1.01	8.45	105	8.75	13.	0.	108.	403.0	1.01	20.45	249	20.75	7.	13.	129.	405.1
1.01	8.50	106	8.83	13.	0.	108.	403.0	1.01	20.50	250	20.83	7.	13.	129.	405.1
1.01	8.55	107	8.92	13.	0.	108.	403.0	1.01	20.55	251	20.92	7.	12.	129.	405.1
1.01	9.00	108	9.00	13.	0.	108.	403.0	1.01	21.00	252	21.00	6.	12.	129.	405.1
1.01	9.05	109	9.08	13.	0.	108.	403.0	1.01	21.05	253	21.08	6.	11.	129.	405.1
1.01	9.10	110	9.17	13.	0.	108.	403.1	1.01	21.10	254	21.17	6.	11.	129.	405.1
1.01	9.15	111	9.25	13.	0.	108.	403.1	1.01	21.15	255	21.25	5.	10.	129.	405.1
1.01	9.20	112	9.33	13.	0.	108.	403.1	1.01	21.20	256	21.33	5.	10.	129.	405.1
1.01	9.25	113	9.42	13.	0.	108.	403.1	1.01	21.25	257	21.42	5.	9.	129.	405.1
1.01	9.30	114	9.50	13.	0.	108.	403.1	1.01	21.30	258	21.50	5.	9.	129.	405.1
1.01	9.35	115	9.58	13.	0.	108.	403.1	1.01	21.35	259	21.58	4.	9.	129.	405.1
1.01	9.40	116	9.67	13.	0.	109.	403.1	1.01	21.40	260	21.67	4.	8.	129.	405.1
1.01	9.45	117	9.75	13.	0.	109.	403.1	1.01	21.45	261	21.75	4.	8.	129.	405.1
1.01	9.50	118	9.83	13.	0.	109.	403.1	1.01	21.50	262	21.83	4.	8.	129.	405.1
1.01	9.55	119	9.92	13.	0.	109.	403.1	1.01	21.55	263	21.92	4.	8.	129.	405.1
1.01	10.00	120	10.00	13.	0.	109.	403.1	1.01	22.00	264	22.00	4.	7.	129.	405.1
1.01	10.05	121	10.08	13.	0.	109.	403.2	1.01	22.05	265	22.08	4.	7.	129.	405.1
1.01	10.10	122	10.17	13.	0.	109.	403.2	1.01	22.10	266	22.17	4.	7.	129.	405.1
1.01	10.15	123	10.25	13.	0.	109.	403.2	1.01	22.15	267	22.25	4.	7.	129.	405.1
1.01	10.20	124	10.33	13.	0.	109.	403.2	1.01	22.20	268	22.33	4.	7.	128.	405.1
1.01	10.25	125	10.42	13.	0.	109.	403.2	1.01	22.25	269	22.42	4.	6.	128.	405.1
1.01	10.30	126	10.50	13.	0.	109.	403.2	1.01	22.30	270	22.50	4.	6.	128.	405.1
1.01	10.35	127	10.58	13.	0.	110.	403.2	1.01	22.35	271	22.58	4.	6.	128.	405.1
1.01	10.40	128	10.67	13.	0.	110.	403.2	1.01	22.40	272	22.67	4.	6.	128.	405.1
1.01	10.45	129	10.75	13.	0.	110.	403.2	1.01	22.45	273	22.75	4.	6.	128.	405.1
1.01	10.50	130	10.83	13.	0.	110.	403.2	1.01	22.50	274	22.83	4.	6.	128.	405.1
1.01	10.55	131	10.92	13.	0.	110.	403.2	1.01	22.55	275	22.92	4.	6.	128.	405.1
1.01	11.00	132	11.00	13.	0.	110.	403.3	1.01	23.00	276	23.00	4.	6.	128.	405.0
1.01	11.05	133	11.08	13.	0.	110.	403.3	1.01	23.05	277	23.08	4.	6.	128.	405.0
1.01	11.10	134	11.17	13.	0.	110.	403.3	1.01	23.10	278	23.17	4.	6.	128.	405.0
1.01	11.15	135	11.25	13.	0.	110.	403.3	1.01	23.15	279	23.25	4.	5.	128.	405.0
1.01	11.20	136	11.33	13.	0.	110.	403.3	1.01	23.20	280	23.33	4.	5.	128.	405.0
1.01	11.25	137	11.42	13.	0.	110.	403.3	1.01	23.25	281	23.42	4.	5.	128.	405.0
1.01	11.30	138	11.50	13.	0.	110.	403.3	1.01	23.30	282	23.50	4.	5.	128.	405.0
1.01	11.35	139	11.58	13.	0.	111.	403.3	1.01	23.35	283	23.58	4.	5.	128.	405.0
1.01	11.40	140	11.67	13.	0.	111.	403.3	1.01	23.40	284	23.67	4.	5.	128.	405.0
1.01	11.45	141	11.75	13.	0.	111.	403.3	1.01	23.45	285	23.75	4.	5.	128.	405.0
1.01	11.50	142	11.83	13.	0.	111.	403.3	1.01	23.50	286	23.83	4.	5.	128.	405.0
1.01	11.55	143	11.92	13.	0.	111.	403.4	1.01	23.55	287	23.92	4.	5.	128.	405.0
1.01	12.00	144	12.00	13.	0.	111.	403.4	1.02	0.00	288	24.00	4.	5.	128.	405.0

CM&T

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INFLOW AND OUTFLOW 100% PMF
HILLTOP FISHING LAKE DAM M040064

EXHIBIT 8

CH2M HILL

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

SUMMARY TABLE 50% PMF
HILLTOP FISHING LAKE DAM MO40064

EXHIBIT 9

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS RATIO 1 .50
HYDROGRAPH AT	INFLOW	.02	1	242.
		(.06)		(6.86)(
ROUTED TO	LAKE	.02	1	0.
		(.06)		(0.00)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	401.30	404.90	404.90
STORAGE	91.	127.	127.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	403.88	0.00	116.	0.	0.00	0.00	0.00

CWMS

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

SUMMARY TABLE, IDENTIFICATION OF OVERTOPPING PERCENTAGE OF PMF
HILLTOP FISH'G LAKE DAM MO40064

EXHIBIT 10

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .60	RATIO 2 .65	RATIO 3 .70
HYDROGRAPH AT	INFLOW	.02	1	291.	315.	339.
		(.06)		(8.24)(	8.92)(	9.61)(
ROUTED TO	LAKE	.02	1	0.	0.	1.
		(.06)		(0.00)(	0.00)(	.02)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	401.50	404.90	404.90
STORAGE	93.	127.	127.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.60	404.52	0.00	123.	0.	0.00	0.00	0.00
.65	404.74	0.00	125.	0.	0.00	0.00	0.00
.70	404.96	.06	127.	1.	2.83	24.00	0.00

CMT

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

SUMMARY TABLE 100% PMF
HILLTOP FISHING LAKE DAM MO40064

EXHIBIT 11

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS
OPERATION	STATION	AREA	PLAN	RATIO 1
				1.00
HYDROGRAPH AT	INFLOW	.02	1	485.
		(.06)		(13.73)(
ROUTED TO	LAKE	.02	1	167.
		(.06)		(4.74)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

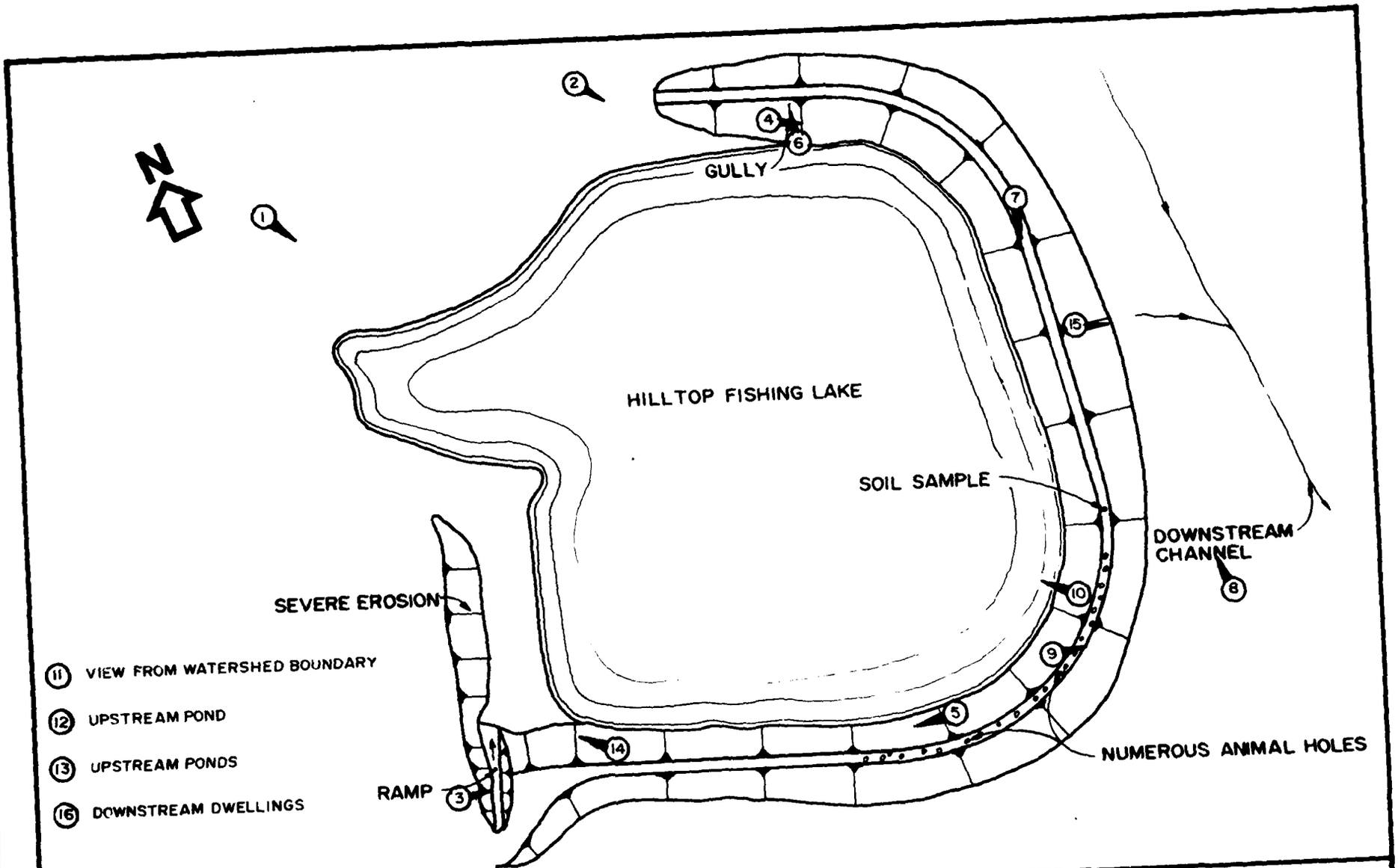
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	402.60	404.90	404.90
STORAGE	104.	127.	127.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	405.48	.58	133.	167.	8.58	15.75	0.00

PHASE I INSPECTION REPORT

APPENDIX C

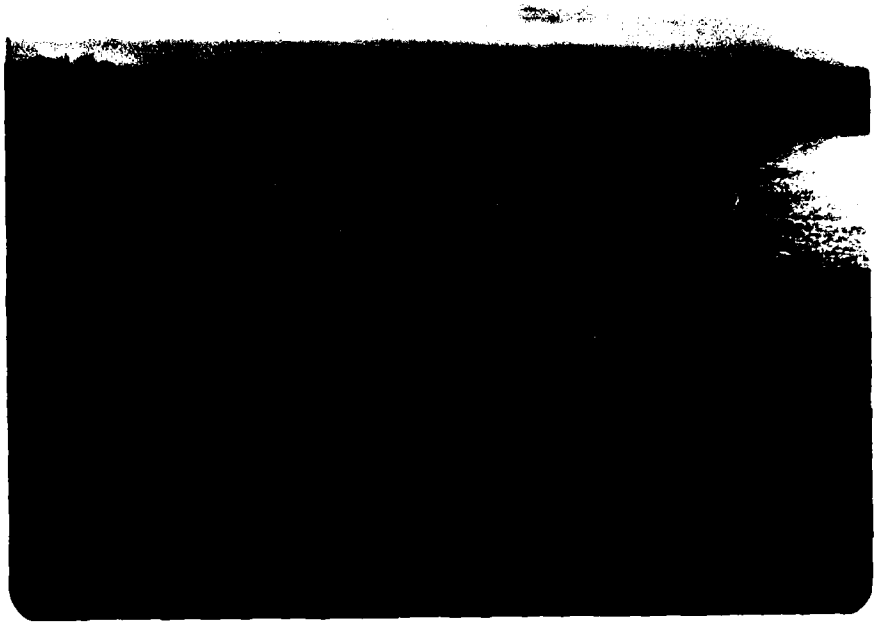
PHOTOGRAPHS



CRAWFORD, MURPHY & TILLY, inc. Consulting Engineers
SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL

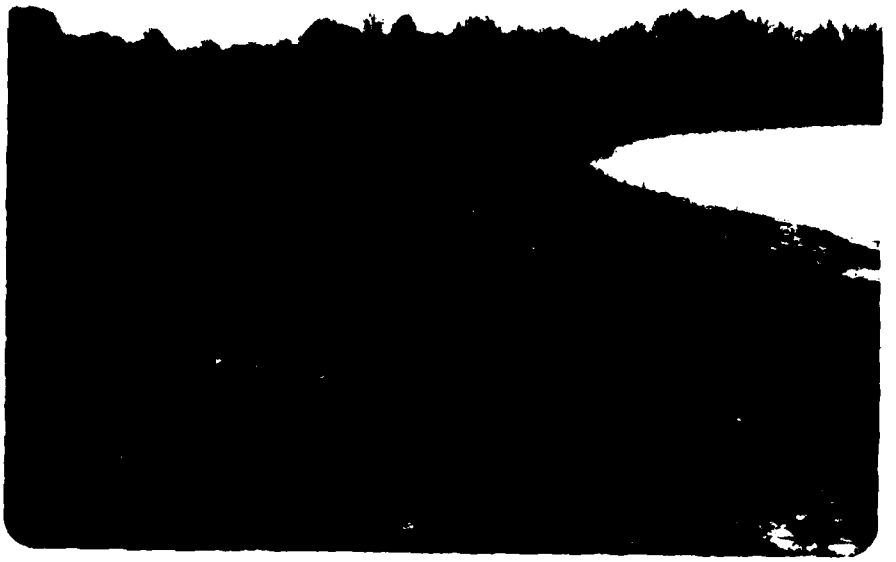
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

PHOTOGRAPH INDEX
HILLTOP FISHING LAKE DAM MO40064



Photograph 2. Crest and upstream face of dam as viewed from the left abutment.

Photograph 3. Crest and upstream face of dam as viewed from near the right abutment. Side slope of ramp is shown in the foreground.



Photograph 4. Upstream face of dam near the left abutment.

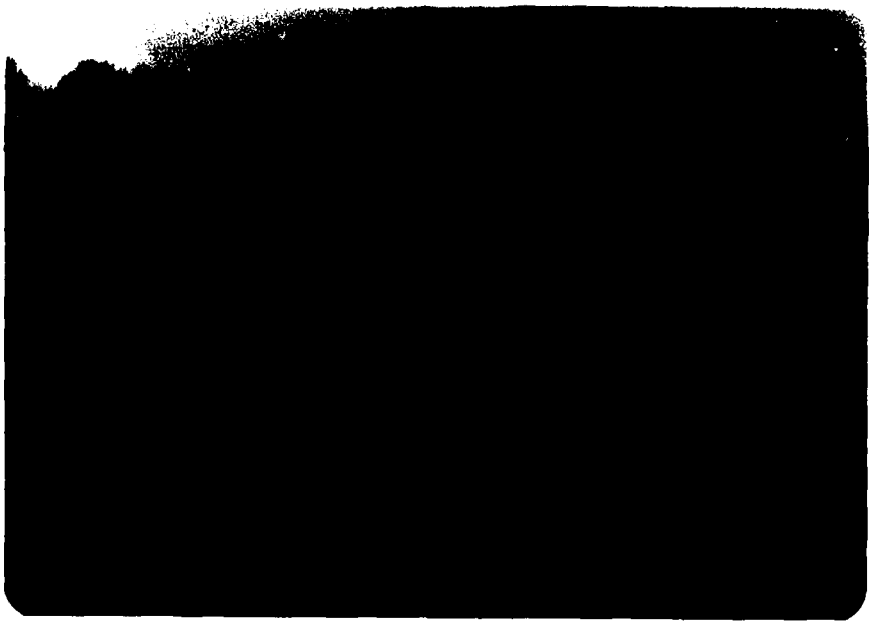
Photograph 5. Upstream face of dam looking toward the right abutment.

Photograph 6. Erosion gully on the upstream face of the dam.

Photograph 7. Crest and downstream face near center of dam.

Photograph 8. Downstream face near center of dam.

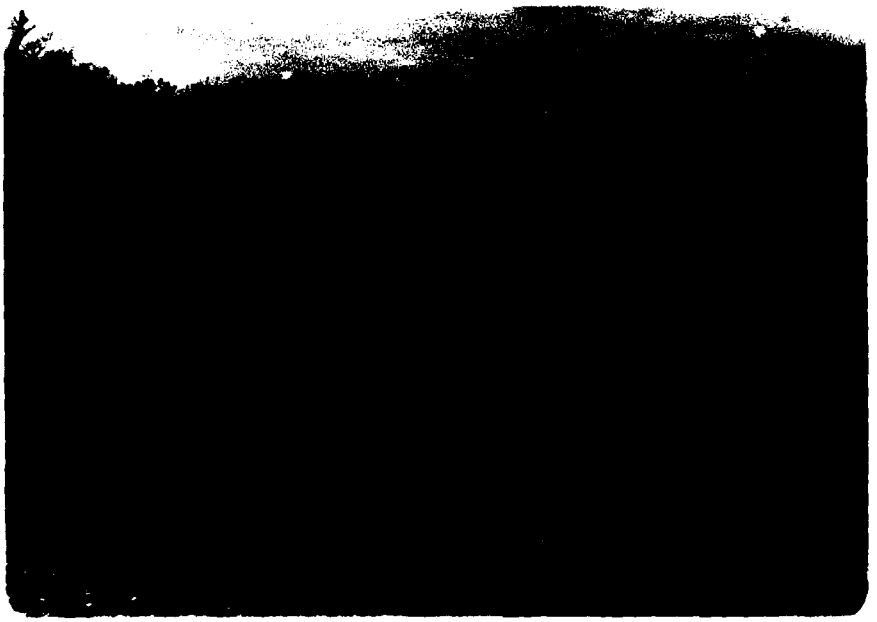
Photograph 9. Hole in crest of dam.



Photograph 10. View of lake and watershed from dam.

Photograph 11. View of watershed from upstream boundary. The three ponds are just off the photograph on the right.

Photograph 12. Upstream pond and discharge pipe from 8-inch diameter well.



Photograph 13. View of the two ponds farthest upstream.

Photograph 14. View of erosion on slope at the upstream edge of the lake near the right abutment.

Photograph 15. Draw located just downstream of dam.

Photograph 16. View of dwellings about 0.3 miles downstream from the dam. The downstream channel can be seen at the right of the photograph.


DATE
IL ME